Compressed Air Magazine

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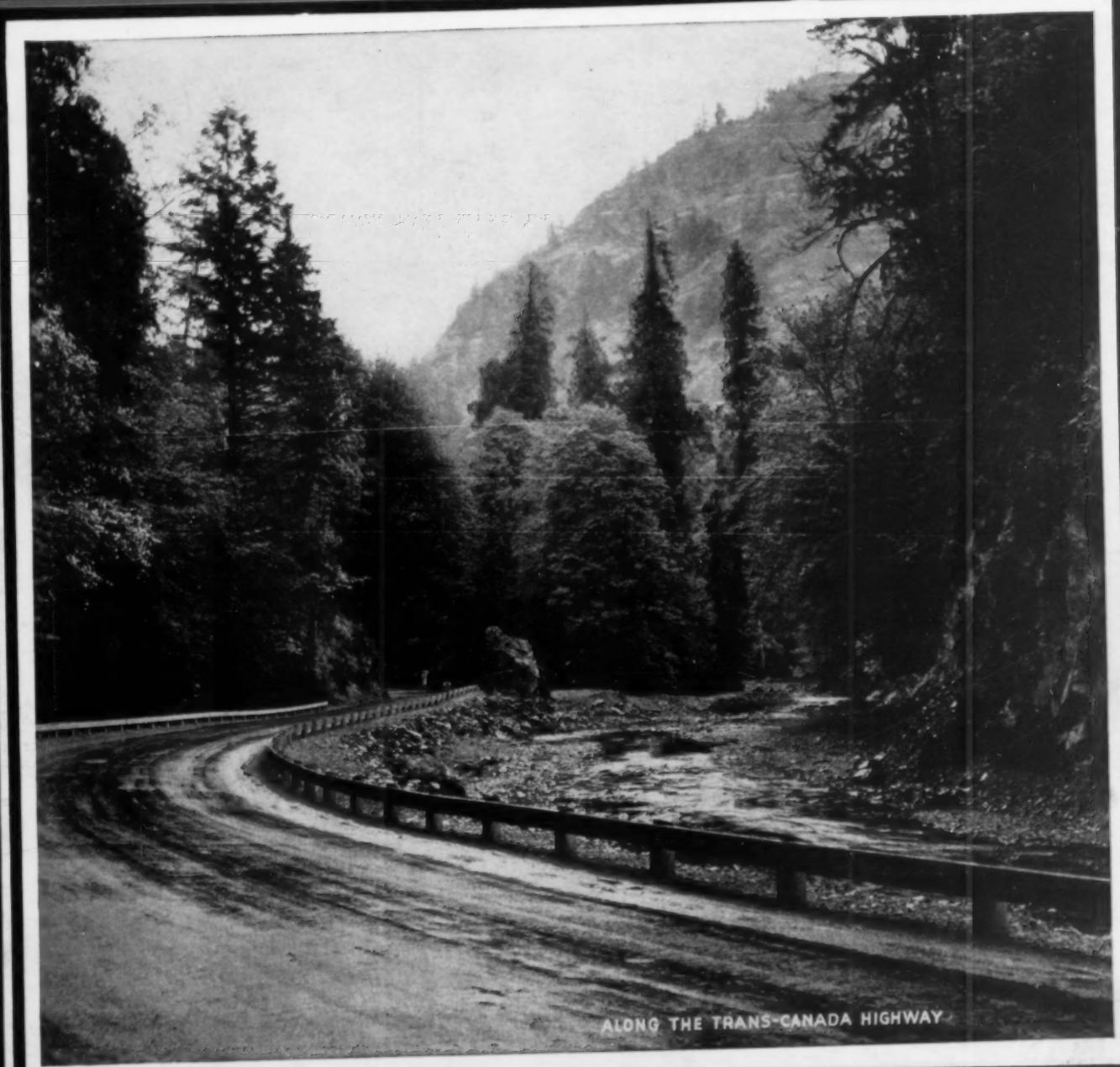
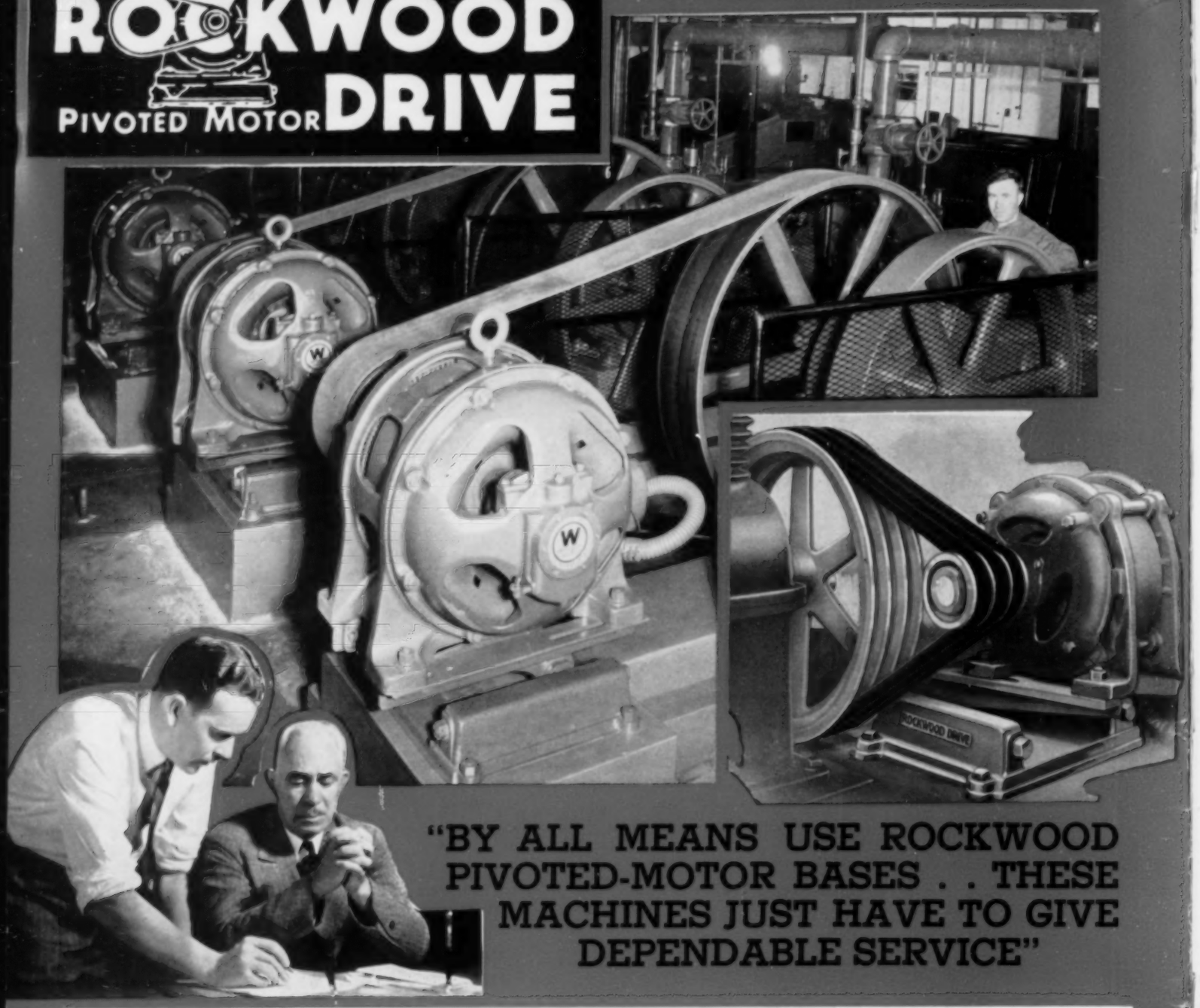


ALONG THE TRANS-CANADA HIGHWAY

ROCKWOOD PIVOTED MOTOR DRIVE



"BY ALL MEANS USE ROCKWOOD PIVOTED-MOTOR BASES . . THESE MACHINES JUST HAVE TO GIVE DEPENDABLE SERVICE"

FOR FLAT BELTS OR V BELTS - ALL SHORT CENTER BELT DRIVEN COMPRESSORS NEED TO HAVE THEIR BELTS KEPT TIGHT AUTOMATICALLY

ROCKWOOD Drives definitely have taught compressor users that ALL SHORT CENTER DRIVES NEED THE PIVOTED MOTOR BASE TO AUTOMATICALLY KEEP their belts tight. BECAUSE all belts stretch—and on short centers even a slight amount of stretch, or elongation, **causes belt slippage**—RESULTING compressor speeds **slow down**—and costly power is wasted.

When the motor is mounted on a Rockwood pivoted base the belts are not only kept tight but kept at the **right** tightness—compressor capacity is increased—and the saving in power runs into real money.

This is because the pivoted motor mounting automatically and instantly—**increases or decreases belt tension with each change in load.** Due to this simple yet remarkable phenomina you get as near perfect drive performance as if you had an operator constantly with his hand on a control lever—or an "electric eye" with elaborate Rube Goldberg mechanism to meet the continuing change in torque.

With Rockwood Drives you invariably get either more air for the same power or the same air for less power—AND your compressor performance is **more dependable.**

Rockwood Bases are in stock for up to 50 h.p. motors. For larger motors the base can be shipped in a few days. **They are easy to install and use.** WRITE US OR ASK YOUR NEARBY ROCKWOOD DEALER FOR PRICES.

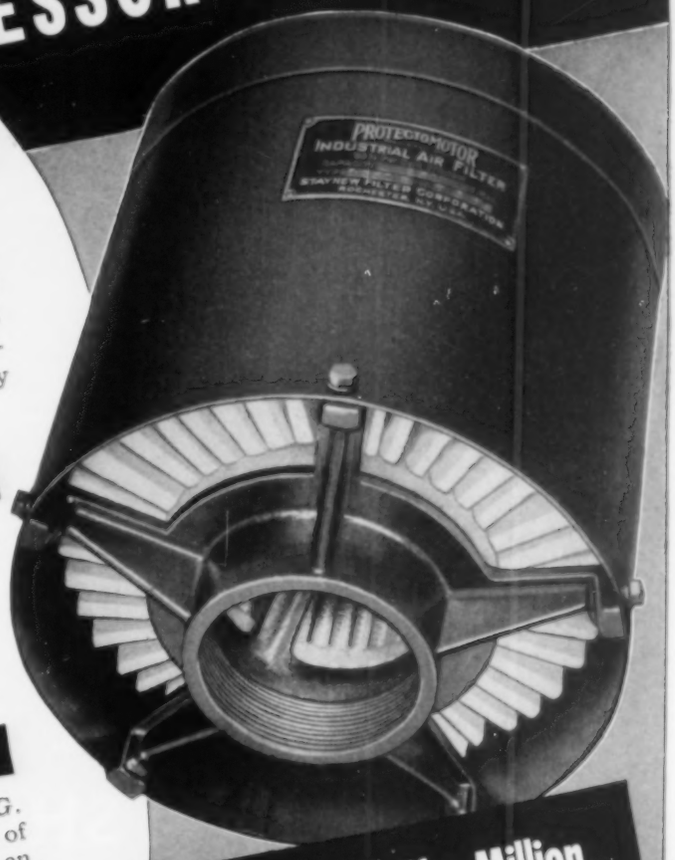
Send For This Book

A valuable book of complete engineering and pricing data on Rockwood Drives - - with over 100 installation pictures FREE. You will want a copy. Ask your dealer or write us.

ROCKWOOD MANUFACTURING COMPANY, INDIANAPOLIS, IND.

Manufacturers of Power Transmission Equipment

WHY PROTECTOMOTOR INTAKE FILTERS ARE BEST FOR AIR COMPRESSOR USE



★ HIGH EFFICIENCY WHEN INSTALLED

All Protectomotor Air Filters for internal combustion engines and compressors feature the exclusive, dry-type Feltex Filtering Medium. This medium passes air freely, yet restricts the passage of even microscopic dust particles. Used in the patented Radial Fin Construction, tests made by the University of California show it to possess an efficiency only .1% less than absolute.

★ INCREASED EFFICIENCY WITH USE

A limited amount of dust clings to the outside of the filter medium during use. This amount is limited by vibration transmitted from the engine, which shakes off most of the dust. The remainder acts as a filter, *increasing* efficiency with use instead of decreasing it, as in liquid-type filters.

★ LOW RESTRICTION TO AIR FLOW

Protectomotors used as rated offer *only* ½" *W. G. restriction to air flow*, yet after months or years of use this restriction will not increase to more than an inconsequential 1" W.G.—remaining at this point during the life of the filter—due to the Radial Fin Construction which permits the largest possible area of filtering surface to be used in the smallest possible space, plus the shaking action of engine vibration on the vertical fins.

★ SERVICING SELDOM NECESSARY

The Protectomotor is a masterpiece of simple, rugged construction. There are no moving parts, no reservoirs, no liquids. The only servicing ever required is the removal of the Insert for cleaning—perhaps once a year under average conditions. Cleaning can usually be effected in 5 or 10 minutes with compressed air or a stiff brush.

★ LONG LASTING ★ ★ ★

Massive, over-gauge materials are used throughout, corrosion proof wherever required, without moving parts to wear out or break; it is not surprising that many Protectomotors have been in continuous use for more than 10 years.

More than Half a Million Installations on Internal Combustion Engines and Compressors since 1920

Write for Catalog and Data Blank for Free Analysis of your Requirements

Radial Fin Construction

PROTECTOMOTOR
99 9/10 Per Cent EFFICIENT
AIR FILTERS

STAYNEW FILTER CORP.
7 Leighton Ave., Rochester, N. Y.
"Air Filter Headquarters"

Size C Hoist with trolley mounting.
Size 3F Surface Grinder equipped with sanding head.
Size 533 Impact Wrench.
Size C3 Chipping and Calking Hammer.
Size 6A Riveter.
MODERN
I-R AIR TOOLS
FOR THE MODERN
SHOP
Size 30 Non-Reversible "Multi-Vane" Close-Quarter Drill.
Size 3H Non-Reversible "Multi-Vane" Drill.

Modern I-R Air Tools Save Money Because:

1. *They are flexible* . . . the torque and speed can be varied at will . . . they can be started and stopped instantly.
2. *They are light in weight and small in size* . . . they increase the operator's capacity to work . . . tire him less.
3. *Maintenance costs are low* . . . they are simple in design . . . are seldom out of order.

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y. 8-22

Atlanta	Buffalo	Cincinnati	Denver	El Paso	Kansas City	Newark	Philadelphia	Pottsville	Scranton	St. Paul
Birmingham	Butte	Cleveland	Detroit	Hartford	Knoxville	New Orleans	Picher	Salt Lake City	Seattle	Tulsa
Boston	Chicago	Dallas	Duluth	Houston	Los Angeles	New York	Pittsburgh	San Francisco	St. Louis	Washington

WORTHINGTON COMPRESSOR, 24 x 40 x 34 x 30, in Obear-Nester Glass Co. plant. Compressor end and steam end, as well as 1200 h.p. Skinner Unaflow Engine in plant, are kept at peak, lubricated with TEXACO.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More railroad rolling equipment in the U. S. is lubricated with Texaco than with any other brand.

★ More tourists use Texaco *Fire-Chief* Gasoline than any other brand.

★ More scheduled airline mileage within the U. S. and to other countries is flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

TRAINED CHEEKS and artful handling still produce the finest glassware. But the job of blowing millions of bottles a year in a modern glass plant is one for the iron lungs of an efficient compressor.

In the E. St. Louis, Ill. plant of Obear-Nester Glass Co. is an efficient compressor now delivering air at full pressure *continuously*. Breaking and sticking of valves has been eliminated. Oil consumption is down 50%.

The only change made to secure these outstanding improvements was to use *Texaco Algol Oil.*

Texaco Alcaid, Algol and Ursa Oils are highly stable, resisting gumming, sludging and the formation of carbon deposits. They do not break down under the heat of compression. These oils keep compressor valves and piston rings free, assuring more efficient operation, fewer overhauls.

The outstanding performance that has made Texaco preferred in this field has also made it preferred in the fields listed to the left.

Buyers in these fields are enjoying many benefits. You, too, will find important advantages when you use Texaco Lubricants and Fuels.

Let a Texaco Lubrication Engineer cooperate in securing more dependable operation from your equipment. Phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

Texaco Dealers invite you to enjoy FRED ALLEN in a full-hour program every Wednesday night. CBS, 9:00 E.S.T., 8:00 C.S.T., 10:00 M.S.T., 9:00 P.S.T.

TEXACO Lubricants
FOR ALL COMPRESSORS AND AIR TOOLS

In Rock of Ages granite quarries . . . Bethlehem Superior Hollow Drill Steel 100%

Rock of Ages Quarries, at Barre, Vermont, are among the country's largest granite producers. Their 100 per cent choice of Bethlehem Superior Hollow Drill Steel for all drilling operations is, in itself, a sound recommendation of the quality of the steel.

Here's why Bethlehem Superior is a wise choice for any type of quarrying operation:

There are no pits or hairline cracks on the smooth inner walls of this drill steel, no weak point for fatigue stresses to drive an entering wedge and cause early failure. The accurately centered hole in Bethlehem Superior greatly facilitates forging bits and shanks and eliminates any danger of a "weak wall."

Bethlehem Superior Hollow Drill Steel is pre-tested for "hardenability" to insure simple economical heat-treatment in the field. It is unusually well adapted for use in conjunction with detachable bits.

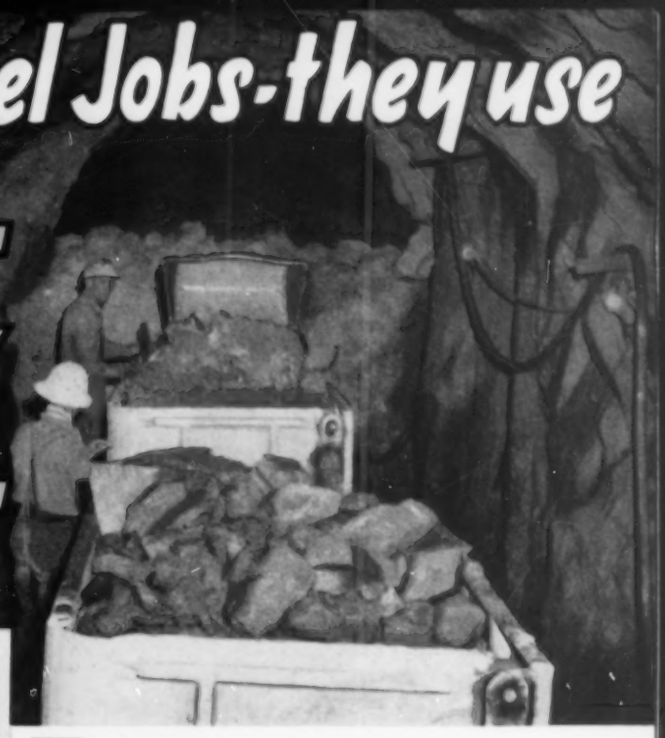
Try Bethlehem Superior Hollow Drill Steel yourself. It is turning in a fine record on all types of drilling jobs from coast to coast. It is thoroughly dependable.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

On High Speed Tunnel Jobs-they use

EIMCO-FINLAY LOADERS

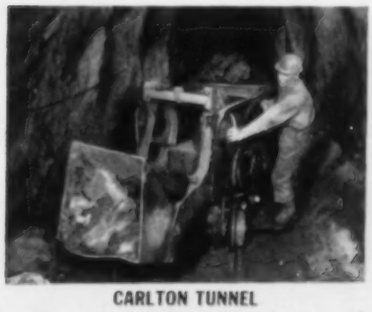


ELTON TUNNEL

At the 23,000 ft. (12 ft. x 12 ft.) Elton Tunnel, near Tooele, Utah, the daily advance averages better than 30 ft.—has been as high as 50 ft.—despite the fact that the tunnel is very wet and must be heavily timbered. Actual loading time per three-ton car averages less than 50 seconds, and a complete train of 16 cars has been loaded in 21 minutes with one Eimco-Finlay Loader as illustrated above.

CONTINENTAL-DIVIDE TUNNEL

Illustration above shows a Model 21 Eimco-Finlay Loader at work in the east portal of the Continental-Divide Tunnel near Estes Park, Colorado. This 12 x 12 ft. tunnel will be 13 miles long when completed. Large illustration at right above shows how completely the 91 cu. ft. cars are filled in from 2 to 2½ minutes, thereby permitting daily advances as high as 51 ft.



CARLTON TUNNEL

All world's records for high-speed footage have been broken again and again in driving the 32,000 ft. (10 ft. x 11 ft.) Carlton Tunnel near Cripple Creek, Colorado. At the end of the fifth mile the average daily advance was 51.46 ft., and on three different days during September, 1940, they made 78 ft. 8½ ft. rounds are mucked out in less than 50 minutes with one Model 21 Eimco-Finlay Loader.

ALPINE-DRAPER TUNNEL

At the 18,000 ft. Alpine-Draper Tunnel, recently completed, near Draper, Utah, each of the two headings (driven to meet) was equipped with a Model 12-B Eimco-Finlay Loader discharging into the hopper of a portable belt conveyor extending over the top of a sufficient number of cars to carry away all of the muck from a 6 ft. round. Complete rounds were loaded out in as little as 30 minutes.

LONG tunnels are being driven faster and more economically today than ever before, and one important reason is because Eimco-Finlay Loaders have solved the mucking problem. Complete rounds are now usually loaded out in less than an hour and mucking costs have been reduced far below all previous figures.

To most mining men, of course, Eimco-Finlay Loaders are nothing new. Hundreds of progressive companies, the world over, are using them; not only for speeding-up development work in drifts and tunnels, but also for fast, low-cost loading out of raises and stopes. In most cases no attempt is made to equal the speed records established by tunnel contractors, but high mucking capacity is always available when needed and, obviously, a machine which has proved its ability to stand up under the terrific punishment encountered on high-speed tunnel jobs can be relied upon to meet any possible mining requirement with a vast margin of reserve strength and power.

The Model 12-B Eimco-Finlay Loader can be used effectively in drifts as small as 4'-6" wide by 6' high—loads cars up to 50 cu. ft. capacity at the rate of a ton per minute. Model 21, with wider clean-up, loads larger cars at the rate of two tons per minute. Model 40 loads the largest cars used underground at the rate of three tons per minute, yet requires only 7'-6" headroom. Write for bulletins and tell us about your loading requirements.

THE EIMCO CORPORATION

SALT LAKE CITY, UTAH, U.S.A.

NEW YORK, 120 Broadway
EL PASO, Mills Bldg.
CHICAGO, 111 W. Washington St.
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INGERSOLL-RAND CO., LTD.
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* **MINE EQUIPMENT COMPANY LTD.**
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* **MARSMAN TRADING CORPORATION**
Manila and Baguio, Philippine Is.

INTERNATIONAL MACHINERY CO.
Rio de Janeiro, Santiago and Antofagasta

* *Replacement parts carried in stock by agents indicated by asterisks*

THE EIMCO CORPORATION, Salt Lake City, Utah., U.S.A.

I am interested in mechanical loading and would like to receive a copy of your new Bulletin No. 105, with the understanding that no charge or obligation of any kind will be incurred.

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Power Piping Functional HANGERS

Supply the final need in Modern Piping Systems

For improvement and simplification of modern piping systems we recommend the use of FLEX-ANAL CHARTS and Power Piping Functional Hangers.

FLEX-ANAL CHARTS are contained in a technical book entitled Design of Piping for Flexibility, published by Blaw-Knox Company – Power Piping Division, expressly for the use of piping engineers. These charts aid in figuring stresses in high pressure-high temperature piping by means of graphs and highly simplified formulae. FLEX-ANAL CHARTS provide a means of readily determining the magnitude and direction of movements in Piping Systems.*

Power Piping Functional Hangers and vibration eliminators provide for movements of any magnitude and direction within the piping system and eliminate vibration.**

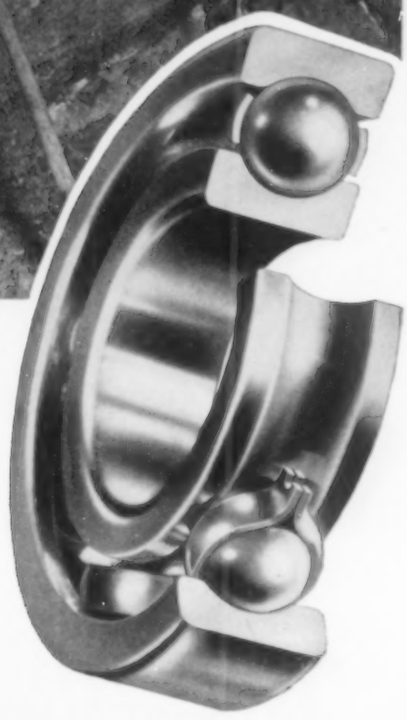
* A copy of "FLEX-ANAL CHARTS" TO ANY ENGINEER ASKING FOR IT ON HIS BUSINESS LETTERHEAD.

**Send for Bulletin entitled POWER PIPING FUNCTIONAL HANGERS AND VIBRATION ELIMINATORS.

BLAW-KNOX COMPANY
POWER PIPING DIVISION

1525 Pennsylvania Ave., Pittsburgh, Pa.

On this Explorer Diamond Drill, built by Ingersoll-Rand Co., SKF Angular Contact Bearings take the thrust of the feed nut assembly, and SKF Deep-Groove Ball Bearings, protected against dirt by labyrinth enclosures, take combined radial and thrust loads on back, motor and journal shaft assemblies.



Dependable Drilling

ON SKF BALL BEARINGS

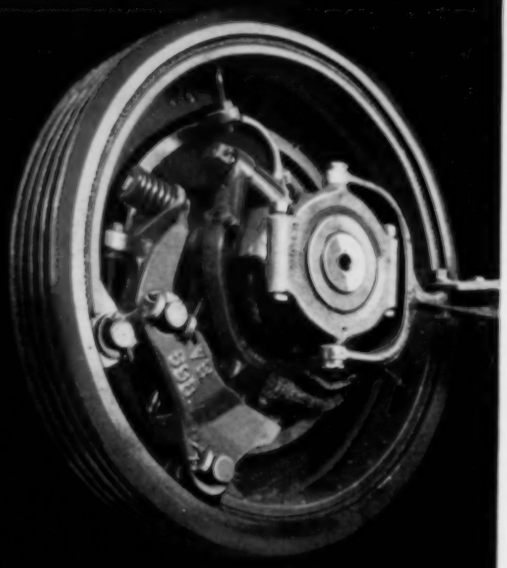
There's no danger of bearing trouble with this Explorer Diamond Drill as it searches for new veins in the dim depths of a mine. That's because the bearings that take the loads . . . the bearings that keep rotating parts functioning freely . . . are SKF's. The simple statement "SKF-equipped" is sufficient to explain the good performance of any machine anywhere.

SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA., PA.

4782

BALL SKF BEARINGS

CRANES *that handle with a smooth, firm grip*



One of four duplicate clutches that give the ¾-yard 20-B its famous direct-action control.

SPEED of operation and accuracy of control on Bucyrus-Erie cranes are, in part, due to the care used in designing the extra large area clutches and brakes so that they take hold uniformly with a smooth firm grip. They keep cool in operation, hold accurate adjustments for long periods. The special linings grip firmly without chattering, and have exceptionally long life.

Provision is made for accurate and convenient adjustment, through a single adjustment unit. Adjustments once made "stay put" on Bucyrus-Erie cranes. The operator always has the feel of the machine and the sure confidence in the clutch and brake action that permits fast, steady operation of the machine at all times.

We believe any shovel, dragline, or crane operator familiar with our modern designs will tell you that Bucyrus-Erie has the smoothest, easiest operating, most dependable clutch and brake system offered by any manufacturer in this field. Find out about the savings fast-moving Bucyrus-Eries offer in your material handling.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN

Don't Scrap it— WELD IT!

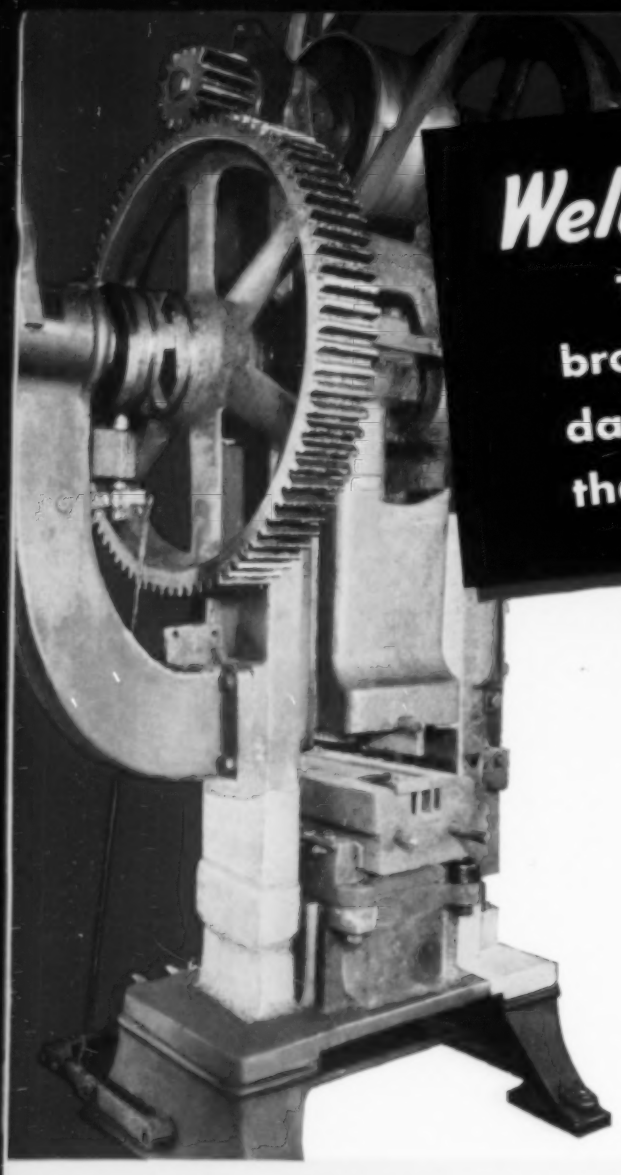
This 2½ ton gear, broken in several places, looked almost impossible to repair. But as in numerous other emergencies, Tobin Bronze welding had the gear back in operation welded, and machined— in less than a week.

With increased industrial activity making difficult the prompt replacement of damaged parts or equipment, Anaconda Bronze welding is saving industry countless dollars by reclaiming and repairing worn or broken equipment—equipment which could not be replaced without weeks or months of delay. Bronze welding has been an industrial economy for many years. Today, it is indispensable. • Tobin Bronze will readily alloy with the clean surface of almost any metal brought to a dull red heat. It was the original Bronze welding rod, developed by The American Brass Company, and it still is one of the most widely used rods for repair-welding cast iron, steel, malleable iron, and copper alloys. • Before scrapping cracked or broken equipment, investigate ALL the possibilities of this speedy, dependable, low-cost method of repair. In addition to Tobin Bronze, other modified alloys are available so that there is an Anaconda Rod suitable for every Bronze welding requirement. Typical examples and a list of Anaconda Welding Rods appear on the pages following.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY • GENERAL OFFICES, WATERBURY, CONN.

BRONZE WELDING IS FAST • DEPENDABLE • ECONOMICAL



Weld it with TOBIN BRONZE

This low-melting-point rod will put broken equipment back into operation days or weeks earlier—at a fraction of the cost of replacement parts.

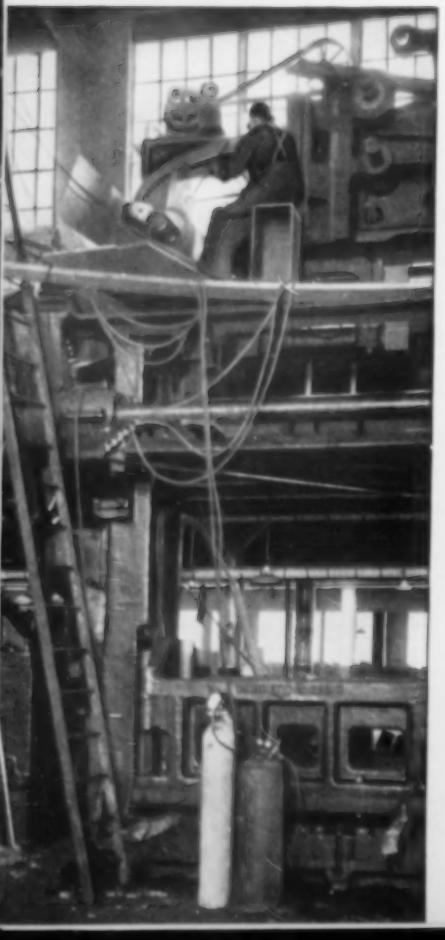
Consider these time and cost-saving advantages:

Bronze welding saves preheating and annealing, time and gas.

Lower temperatures reduce the possibility of warping or cracking — many parts can be welded in position.

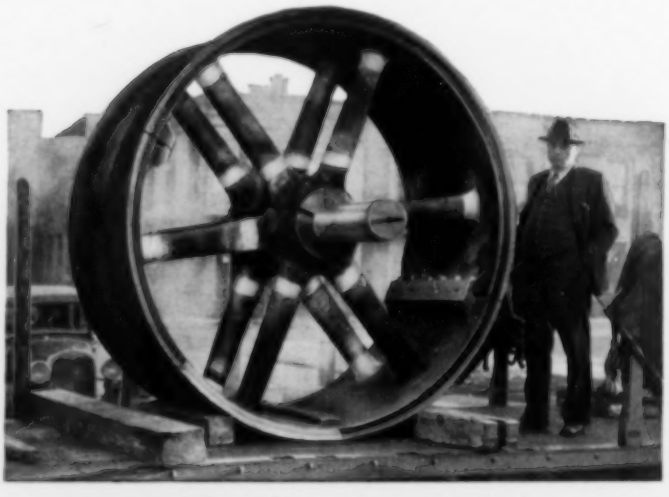
Serious stresses are absent after the weld is completed —parts can be returned to service almost immediately.

Lower temperatures permit fast and economical joining of intricate sections, parts of radically different weights or cross sections, and metals of entirely different compositions.

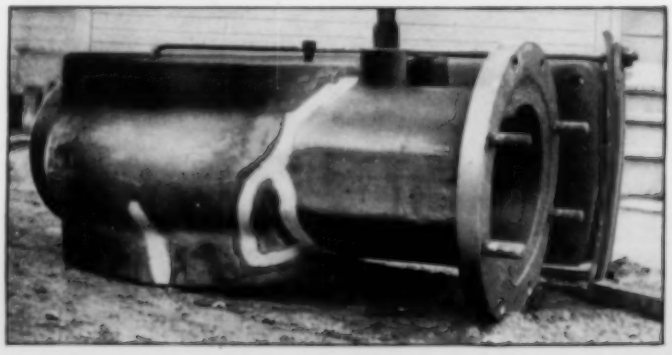


ABOVE: This cast iron forge shop press frame weighs 5,500 pounds. It was Anaconda Bronze welded in 35 man-hours, using 154 pounds of Bronze.

LEFT: This stamping press for automotive parts is an expensive piece of equipment to have out of operation! 10 man-hours, a few pounds of Anaconda Bronze, and the fractured cast iron bearing housing was repaired.

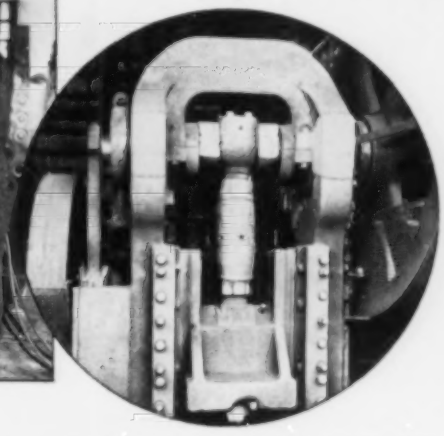


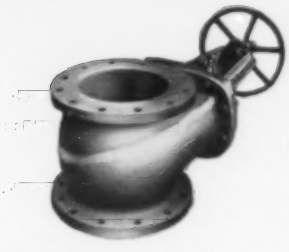
ABOVE RIGHT: All twelve spokes broke on this 84" main drive cast iron pulley in a pulp and paper mill. Four to six weeks for a new one! Anaconda Bronze welding had it back on the job in less than seven working days.



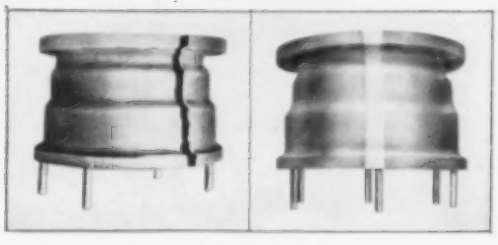
This cast iron oil-engine block was headed for the scrap pile—cracked almost entirely around the cylinder. 10 hours after Anaconda Bronze welding was suggested, the good-as-new casting was ready for service.

Even with a bad break like this, Bronze welding proved its merit. 35 hours for chipping and preheating, 165 pounds of Anaconda 997 Low Fuming Rod, and 11 hours for welding put this soundly repaired press frame back in operation.

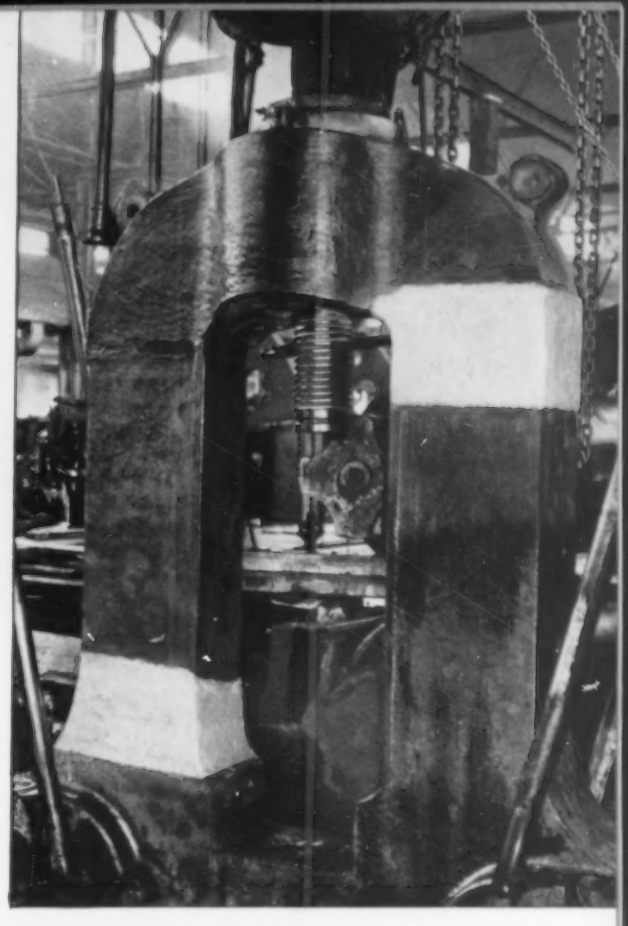




A broken cast iron valve. Production halted. Down-time for replacement too costly. Of course the answer was Anaconda Bronze welding!



A Lakes freighter with a cargo of perishable goods came to a stop when this engine casting cracked. Repaired with Anaconda Bronze in less than an hour, the vessel with its costly cargo was on its way the same day.



When this 15-ton roll housing broke, two temporary repair welds with Anaconda Bronze were tried. Working in two shifts, the welders had the mill back in service in nine days. (P.S. After more than a year, this mill with its "temporary" weld, is STILL turning out its daily quota of metal.)

Are You UP-TO-DATE on BRONZE WELDING?

Bronze welds are regularly being made by the oxy-acetylene method in less than half the time required to weld with ferrous rods. So universal has the use of Bronze welding become in recent years that Anaconda Bronze Rods have been adopted as standard materials for oxy-acetylene repair and construction work in many fields. These Anaconda Products combine high tensile strength, toughness, durability, and uniform composition.

Electric welding of copper alloys by the metallic arc or carbon arc has also made tremendous strides. New uses are continually being developed for Everdur, Anaconda Phosphor Bronze, and Anaconda Copper-Nickel Alloy Rods. Arc welds made with Everdur are exceptionally dense and strong and, by using heavier currents, this metal can be laid down faster than steel.

Anaconda Phosphor Bronze Rods are used to special advantage in the electric welding of copper and its alloys, and for building up worn bearing surfaces and machine parts of steel, especially where resistance to wear is required. The recently developed high-voltage carbon arc method of welding copper, brass and bronze with these rods has given to manufacturers a means of fabricating heretofore unavailable.

The American Brass Company has pioneered in the development of Bronze welding and has available a complete series of Anaconda Welding Rods—a suitable one for almost every gas or electric Bronze welding purpose. Anaconda Publication B-13 describes these rods and suggests procedures for their use. A copy is yours for the asking.

ANACONDA WELDING RODS

	Approx. Melting Point Degrees Cent.	Fahr.
Tobin Bronze*	885	1625
Anaconda 520	885	1625
Manganese Bronze	870	1598
Anaconda 997 (Low Fuming)	870	1598
Economy Bronze*	885	1625
Brazing Metal	930	1706
Everdur*	1019	1866
Phosphor Bronze 903	1050	1922
Phosphor Bronze 369 or 365	1070	1958
Phosphor Bronze 310	1000	1832
Phosphor Bronze 353	1025	1877
Silicon Copper	1083	1981
Silver Bearing Copper	1078	1972
Deoxidized Copper	1083	1981
Electrolytic Copper	1083	1981
Nickel Silver	1055	1931
Super Nickel	1225	2237

*Trade-Marks Reg. U. S. Pat. Off.

THE AMERICAN BRASS COMPANY • *Fabricators of*

Anaconda Welding Rods

HEADQUARTERS FOR

COPPER · BRASS · BRONZE

The doors of The American Brass Company, largest producer of copper and copper alloys, are always open to those seeking helpful technical or engineering cooperation. Our Research Department has produced and tested hundreds of copper-base alloys, and has developed an extensive list of welding rods and procedures for their use. In addition, this Company produces a wide range of Copper, Brass, Bronze and Nickel Silver, in standard compositions and in all commercial forms. Manufacturing plants and warehouses are maintained in strategic industrial areas. Distributors throughout the nation are prepared to make prompt deliveries from their adequate stocks of Anaconda Metals.

PRINCIPAL ANACONDA PRODUCTS

COPPER AND COPPER ALLOYS

COPPER—Arsenical, Deoxidized, Electrolytic, Leaded, and Silver Bearing.

BRASS—From "2 and 1" Yellow Brass to "85-15" Red Brass, Leaded, Naval, Forging, Brazing, and Special.

BRONZE—Commercial, Manganese, Phosphor, Cadmium, Silicon, Architectural, Bushing, Forging, Leaded, Hardware, and Special Bronzes.

NICKEL SILVER—From 5% to 30% nickel content; leaded, from 10% to 18% nickel content.

Admiralty Alloy	Cupro Nickel
Ambrac*	Everdur*
Ambraloy	Muntz Metal
Avialite*	Super Nickel
Benedict Nickel	Tempaloy*
Beryllium Copper	Tobin Bronze*

Write for Publication B-28, a comprehensive booklet on Anaconda Copper Alloys.

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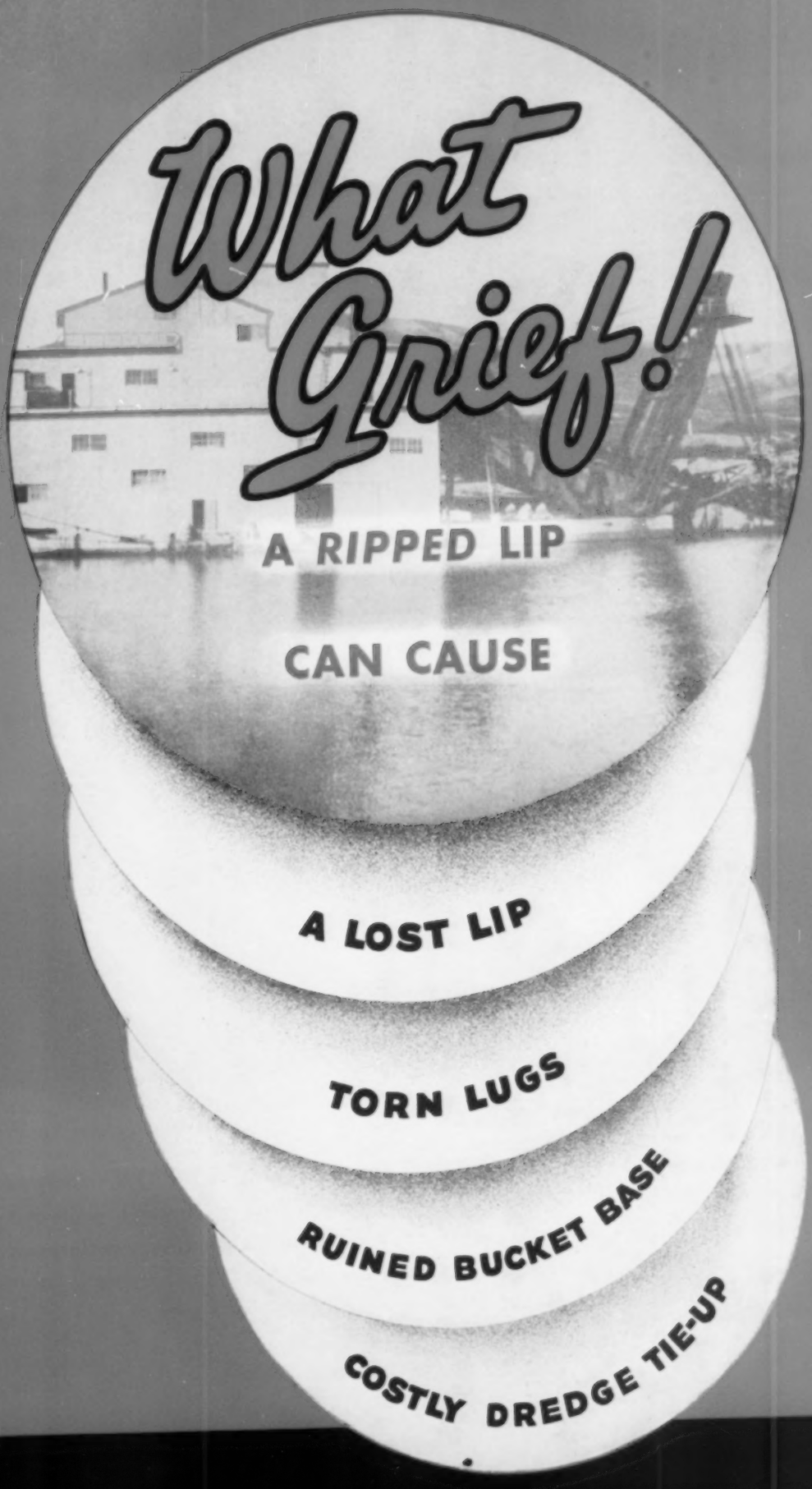

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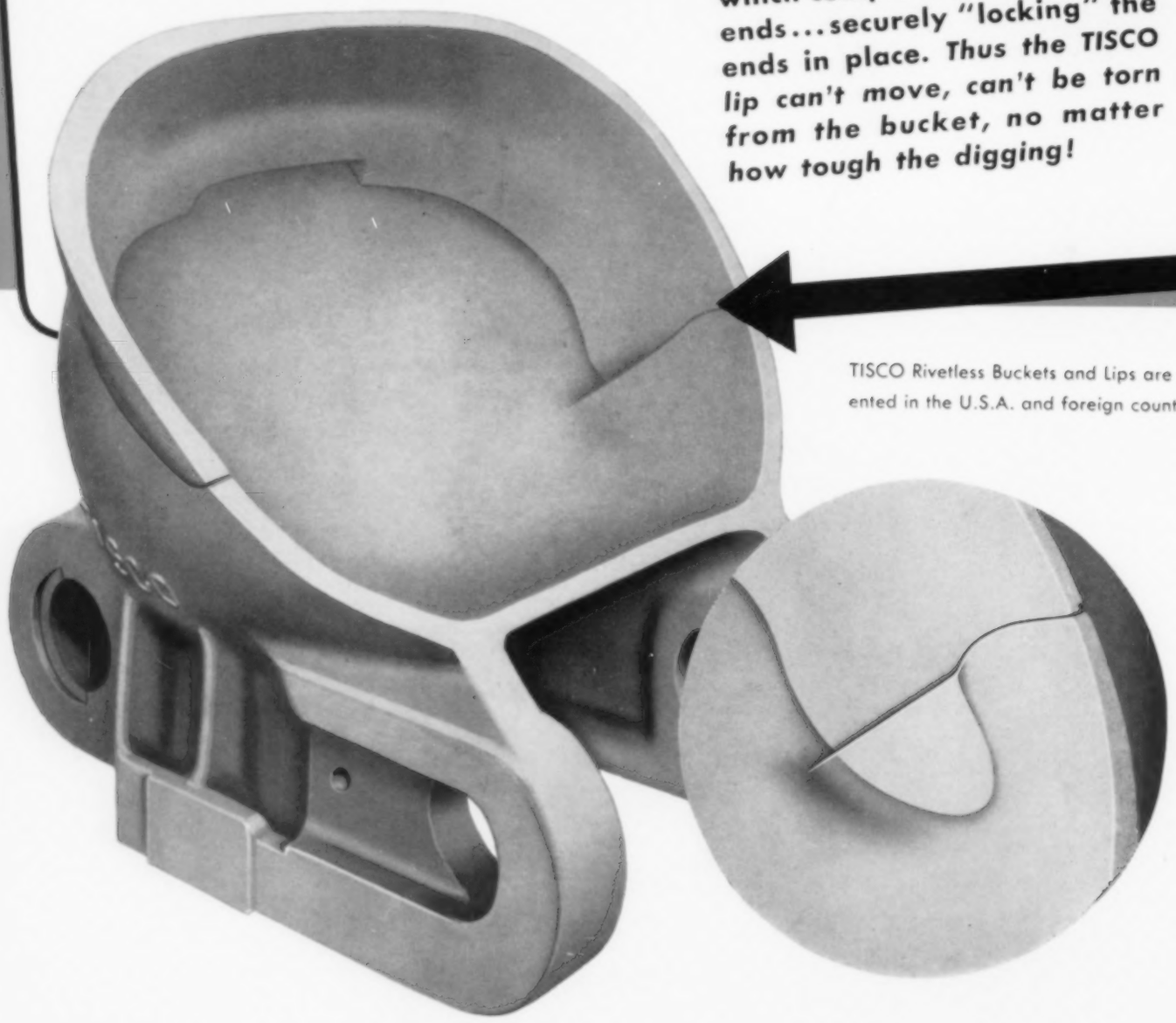

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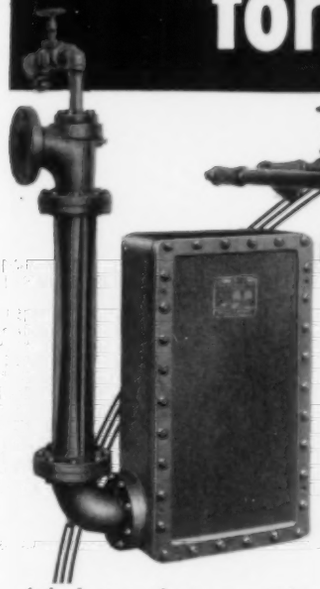
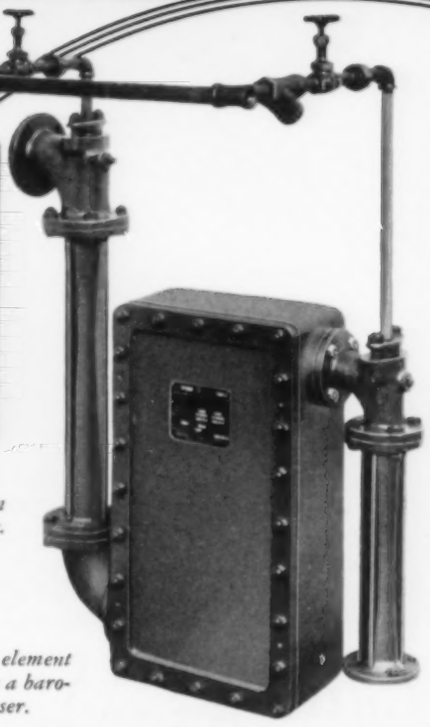
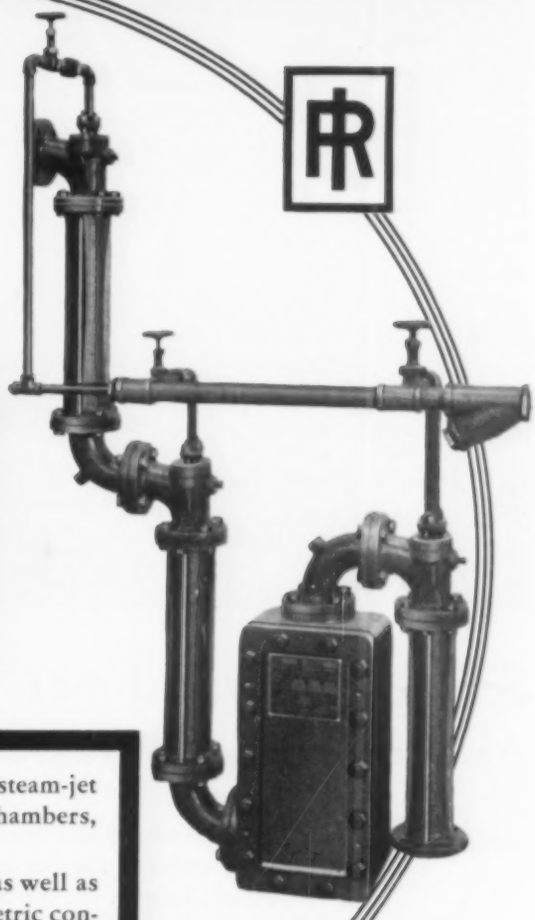


A single-stage ejector mounted on a direct contact aftercondenser.



A two-stage single element ejector mounted on a barometric intercondenser.



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ON THE COVER

OUR cover view shows a stretch along the Big Bend section of the new Trans-Canada Highway. That section has been open less than a year, but it has already been hailed as one of the most scenic drives on the North American Continent. A road built in 1858 was almost entirely destroyed in extending the Canadian Northern Railroad into Vancouver in 1910. The new highway gives the traveler from the East a pleasant introduction to British Columbia, one of the less-known areas of Canada.

•

IN THIS ISSUE

IT SEEMS almost unbelievable that Canada should be spanned by both railway and airway before a highway crossed the country, but that is the case. The Trans-Canada Highway, the final link in which will be completed this year, will make possible for the first time a continuous motor trip between the Atlantic and Pacific oceans without leaving Canadian soil. Our leading article is devoted to this momentous piece of work.

•

THE Carlton Tunnel underneath the mines of Cripple Creek, Colo., is already a success. Water gushed from a fault zone on February 20; drowned out the workings; and, paradoxically enough, made everybody happy. The reason, of course, is that it is a drainage tunnel. It unwatered the Ajax Mine in short order, lowered the water level in the Cresson and Portland shafts, and brought the management to the decision to push to completion not only the main bore but also two projected laterals. Within another year, deep-level production will again be underway in half a dozen mines in that famous old gold camp. Our second article brings the story of this notable tunneling venture up to date.

•

"IT'S an ill wind," etc. Because the war in Europe has put an end to the exportation of the famous Hood River apples, we in this country will have more of this delectable fruit to eat. How these apples are prepared for the market is described in *An Apple a Day*.

•

IDAHO might well be called the "white-metal" state. It leads all others in the output of silver and stands high on the list of zinc and lead producers. Chief among its mineral-yielding areas is the Coeur d'Alene District. A thumb nail historical sketch of this interesting section, with a resumé of its present principal mining operations, has been written by the editor of the *Wallace Miner*.

Compressed Air Magazine

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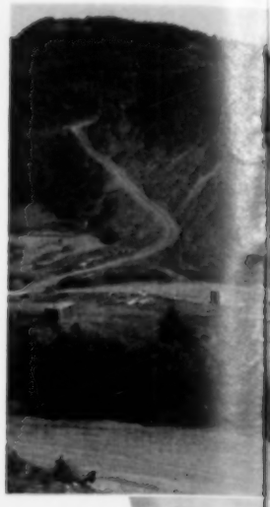
The Trans-Canada Highway

E. L. Chicanot



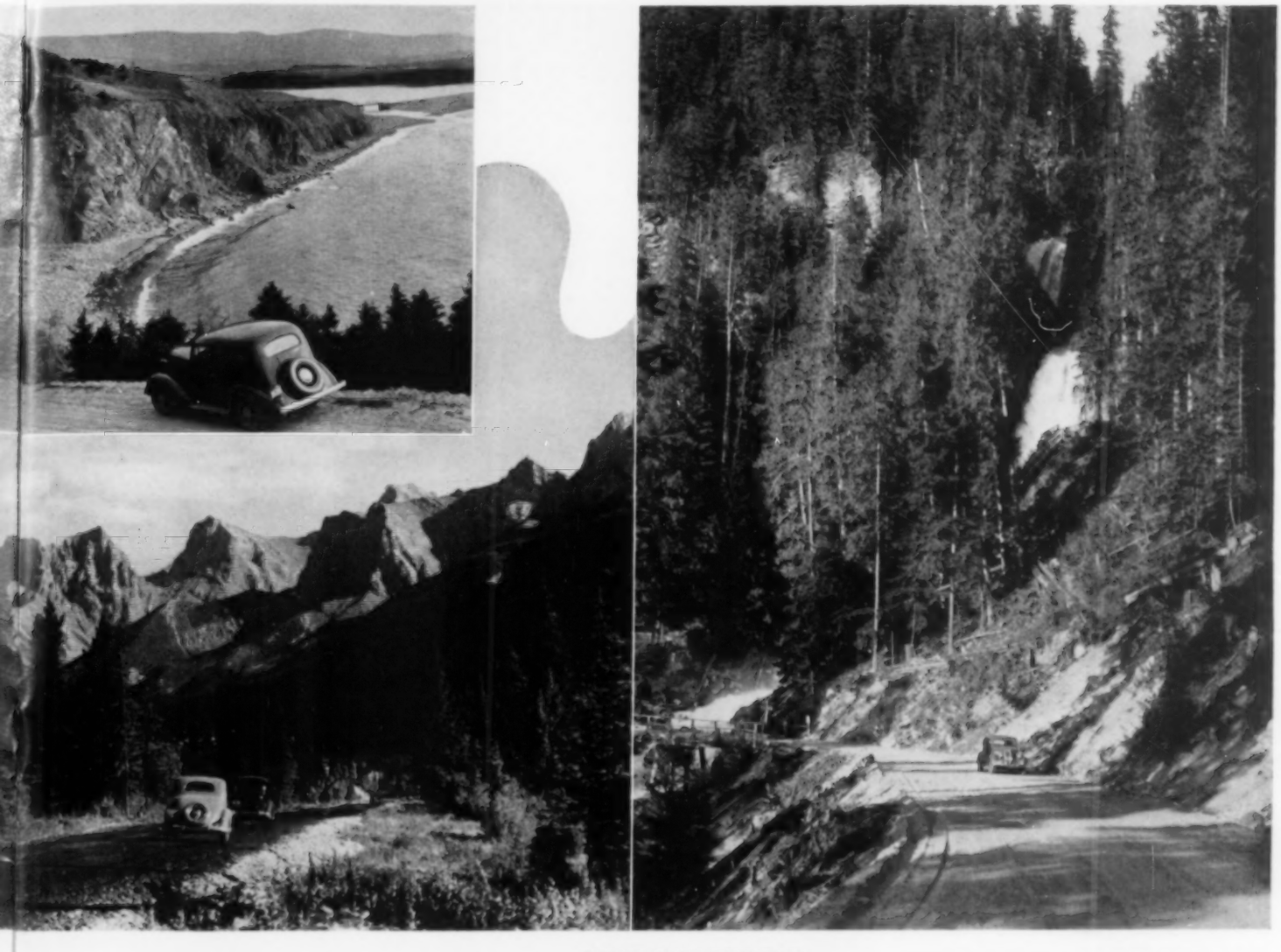
THERE is enormous and widespread satisfaction in Canada over the knowledge that work is progressing on the last gap in the Trans-Canada Highway and over the assurance given that the entire route from the Atlantic to the Pacific will be ready for service by fall. Since the beginning of the year, feverish activity has prevailed throughout 150 miles of Northern Ontario bushland, which is all that now prevents the motorist from driving from one extremity of the Dominion to the other. Probably not this summer, but certainly next, one of the world's longest and most attractive automobile routes will be open to Canadians and numberless guests.

The completion of the Trans-Canada Highway marks the realization of a long-cherished dream—the goal of elaborately directed plans. It is, first of all, a matter of pride with Canadians that they will be able to go by car the breadth of their country without having to encroach on neighboring territory or to depend, periodically, on some other form of transportation. Further, it has long been the belief that such an overland route would, by facilitating interprovincial travel by the ubiquitous automobile, be an important factor in the unification of the Canadian people. Then there is the matter of the touring public to whom the road will unquestionably be an attraction because of the matchless scenic beauty of much of the country traversed. But, aside from all these considerations, there is still another one that has come to the fore only recently as a result of the feverish concentration of war activities in the Dominion. The highway will be of great value from a military standpoint—a vital reason that is hastening its completion.

On the face of it, it may seem strange that only at this comparatively late stage in her history is Canada on the point of linking by roadway the extreme limits of her most-settled area. Uninterrupted transportation by train from coast to coast has been available for more than 50 years; and it has been possible to make an unbroken journey from the Maritimes to British Columbia, all over Canadian territory, by air even before the same thing could be done by highway. That is not so strange, however, when one appreciates the vastness of the Dominion, the ruggedness of the terrain, and the many complexities entailed in developing a transcontinental route that will combine a maximum of practicability with the utmost in attractiveness.

From certain aspects, it might be said with fairness that the task of planning and building has been a bigger one in the case of the highway than in that of either the railroad or the airway. When the first transcontinental railway was constructed, a job admittedly titanic, the sole concern was to join the territorial extremes by the most direct and economic route. As a result, the road lacks scenic appeal—in fact, it traverses some depressing and unpicturesque sections. The trans-Canada airway, while involving a tremendous amount of scientific study and the solution of many new problems, did not have to contend with such laborious and time-consuming tasks as hewing down virgin forests, blasting through rocky wildernesses, and solidifying muskegs, etc., such as confront the highway builder.

The Trans-Canada Highway is the result of gradual and careful long-term de-



VARIETY OF SCENERY

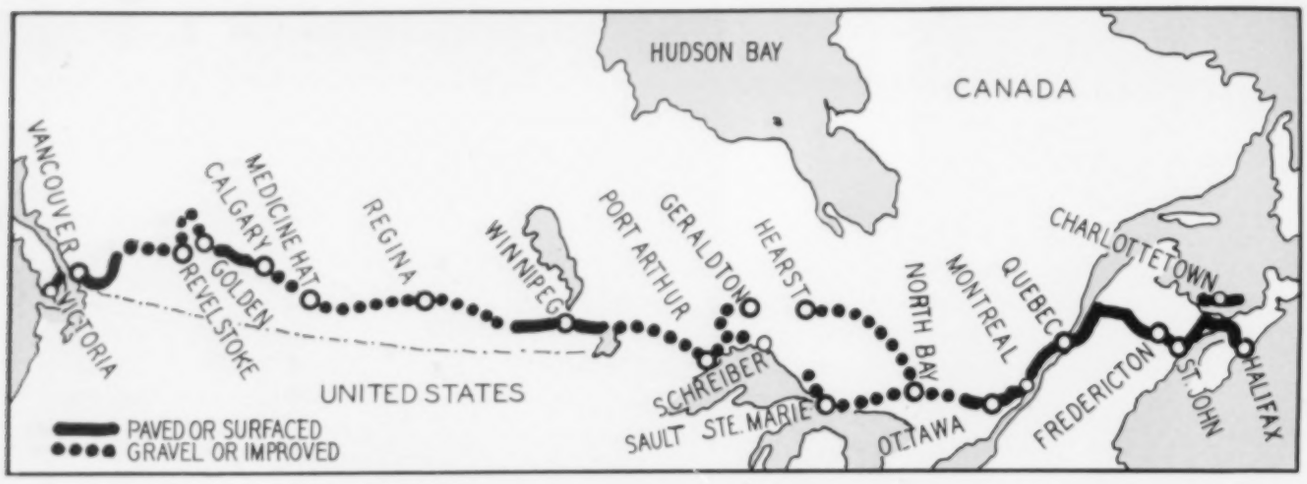
Vistas of every kind will unfold before the motorist on Canada's new highway that will be completed next autumn, years after the country was spanned by rail and air. From left to right: Along the Fraser River Canyon; near Banff, Alberta; top center, Cape Breton National Park, Nova Scotia; and the Big Bend section in British Columbia.

velopment. It was first conceived and promulgated nearly 30 years ago, not so much as a speedway but as an automobile route that was to be only as direct as necessary and to link as many as possible of the areas noted for their historic interest and natural beauty. The traveler in mind when planning it was the vacationist rather than the businessman. The road was to be constructed not as a single project but as a series of sectional highways subsequently to be interconnected to form a continuous transcontinental traffic artery. This further explains why it has taken so long to complete the undertaking.

By reason of the fact that roadbuilding in Canada comes within the jurisdiction of the provinces, each of those through which the overland route passes has had to assume responsibility for the stretch within its own confines, except where it traverses national parks, which are under the control of the Federal government. Otherwise, the latter entered into the picture only as counsel in matters of dispute and when extending financial assistance in the way of subsidies.

Visitors from the United States are as a rule delighted with nearly everything they encounter in Canada. But this does not apply to her highways, of which criticism is not unknown, especially when the driver of a car strays off a main road when weather conditions are adverse. It is admitted that there is justification for it; and every possible step is being taken to remedy the situation. This is good business, for the motor vehicle is one of the biggest assests of the Dominion's economic life. Only four countries possess more automobiles than does Canada; and her per capita ownership, by reason of her small population, is outnumbered only by the United States. In the rural areas, particularly, the motor car has become a revolutionary factor in the life of the people, and one is to be found on every other farm throughout the vast domain. In the tourist season the domestic automobiles are exceeded by those of visiting motorists, whose contribution to Canadian trade is greater than that of any single item of export.

While it is true that the highways are deficient, gauged by American standards, a vigorous program of construction and betterment has been underway for the past 30 years and is now being still more energetically prosecuted. In the first place, local demands for road paving and improvement have been so insistent that little emphasis could be laid on the broader, national requirements. The conception of a Trans-Canada Highway did not arouse much enthusiasm in those whose chief interest lay in getting better suburban thoroughfares and market roads. But all the while it was gradually evolving as a by-product of a transprovincial and interprovincial system that was being



ROUTE OF THE HIGHWAY

From Nova Scotia to Vancouver Island, the highway will have a length of 4,244 miles. It will pass through the principal cities in the eastern part of Canada and will include some of the finest upland scenery in its Rocky Mountain section. It will be open throughout its full length for only six months of the year; but in summer it will provide a route across the North American Continent that will be free from oppressive heat, desert wastes, and badlands.

promoted by direct planning and financial aid on the part of the Federal government.

In 1919, the Canada Highway Act was passed as a postwar reconstruction and employment measure, and it has been a major factor in the development of the country's roads in general and the Trans-Canada Highway in particular. It made available a sum of $20,000,000 from which amounts were to be advanced to the provinces equal to those contributed by them for roadbuilding. At the same time, envisaging the completion of a transcontinental network, it called for the preparation by each province of a program map showing its main and market roads connected at provincial boundaries so as to form a national trunk system. A second series of subsidies was designed to relieve unemployment resulting from the depression; and between 1930 and 1940 another $20,000,000 was paid out to the provinces for the same purposes and on the same terms.

Figures of highway construction in Canada have meaning only when one appreciates the immensity of the land, the primitive conditions prevailing throughout vast areas, the comparatively recent inauguration of a large-scale modern-road program, and the financial difficulties that are involved. Her highways now have an aggregate length of 500,000 miles—nearly twenty times the circumference of the earth, and of these more than 100,000 miles are hard-surfaced, all representing an investment exceeding $1,000,000,000. While great stretches of northern Quebec, Ontario, the prairie provinces, and British Columbia are sparsely inhabited and have very few roads, the southern sections are well populated and served. It is largely through these, roughly paralleling the international boundary, that the Trans-Canada Highway runs.

Gradually, the provincial roads have been incorporated in the transcontinental highway, as originally planned; and when the present war broke out there were but two gaps to be closed. One of these was finished last year, and work on the other is proceeding rapidly. The first of the two formidable stretches that stood in the way of an uninterrupted trip from coast to coast by automobile was the "Big Bend" Highway between Golden and Revelstoke in British Columbia. It follows the course of the Columbia River through the Rocky Mountains and is 193 miles long, though the rail distance between the two points is only 90 miles. The additional length is fully justified, because it has meant the incorporation in the road of some of the most magnificent rugged landscape in the Rockies. Before the "Big Bend" was opened to traffic in June, 1940, motorists loaded their vehicles on automobile cars attached to the train they themselves boarded, and thus negotiated the incompleted

SECTION NEAR TORONTO

Stretches of the new road are finished according to the best standards of arterial highways in the United States. The one shown here is between Toronto and Hamilton, in Ontario.

AIDS TO THE ROADBUILDER

The portable air compressor, the wagon drill, and the Jackhamer are always in the vanguard of roadbuilding forces wherever there is rock to be moved. Much of the Trans-Canada Highway has involved heavy drilling and blasting. Thanks to dependable air-powered equipment, this work has been carried on in summer and winter alike, as the accompanying pictures attest.

section without going out of their way.

All that now remains to be done is the 150-mile stretch between Hearst and Geraldton, north of Lake Superior in Ontario. But, even so, the motorist is able to travel cross country in Canada, bridging the gap by boarding a steamer with his car at Sault Ste. Marie and going to the twin cities of Port Arthur and Fort William at the northwest head of the lake—or *vice versa*, a comfortable 250-mile journey.

Aside from being the last link in the through route, the Hearst-Geraldton section may prove to be important in itself. It will open to automobile traffic a vast region in northern Ontario that has promising natural resources and that offers great attractions to sportsmen and tourists. Recent geological investigations indicate that the area may contain minerals worthy of development. The right of way for this final stretch was laid out by aerial surveying, which was found to be far better and quicker than ground surveying in that region of dense virgin forests. The cost of the work was only a fraction of what it would have been if the conventional method had been followed.

Construction of the Hearst-Geraldton link will cost about $6,000,000. At the western end considerable clearing has already been done by convict labor, which will be employed to build that particular part of the roadway. Two hundred and fifty prisoners are housed in three camps, one of which has been designed to serve as a permanent stopping place for tourists and sportsmen when the project is completed. The remainder will be constructed under contracts, and has been divided into fifteen sections to speed up the work.

The Trans-Canada Highway begins on an island in the Atlantic and ends on an island in the Pacific. According to the official designation, it extends from Louisbourg, Cape Breton Island, Nova Scotia, (or from Borden, Prince Edward Island) to Victoria on Vancouver Island, British Columbia, a total distance of 4,244 miles. Incorporated in it is the road between Montreal and Quebec, which dates back to 1734, and the 530-mile Dawson Road, the first to connect the East with the praries. The latter was finished in 1871, ten years prior to the turning of sod on the Canadian Pacific Railway. Traversing, as it does, all parts of the country from the historic to the primitive, passing through forest reserves and parks, linking the Federal capital with most of the provincial capitals, cities, towns, villages, and shrines, the overland route furnishes a cross-sectional view of Canada's varied national life.

So many years have passed since the inception of the undertaking, and so slowly has it progressed, that the highway may be opened to through traffic without much notice on the part of the public, especially with the Americas concentrated on matters of greater immediate importance. But the very fact that it is being completed at a time when every effort is bent towards the vigorous prosecution of the war is significant of its value from the standpoint of tourist trade and, first of all, national defense.

Whether or not the road is one of the longest in the world, it is a fact that it adds another transcontinental travel and freightway to those already existing in the Dominion—to railroad and airway, and gives North America one more cross-country route. Although it cannot at present compare with the older ones in the matter of uniformity, and will be available in its entirety but six months of the year, it is the only one that offers an escape from tropic heat during the summertime when Canada is at her loveliest and most enjoyable. It does not traverse long stretches of desert, alkaline wastes, and badlands, and there is solid motoring pleasure in virtually every mile. Scenically it is unrivaled on the continent.

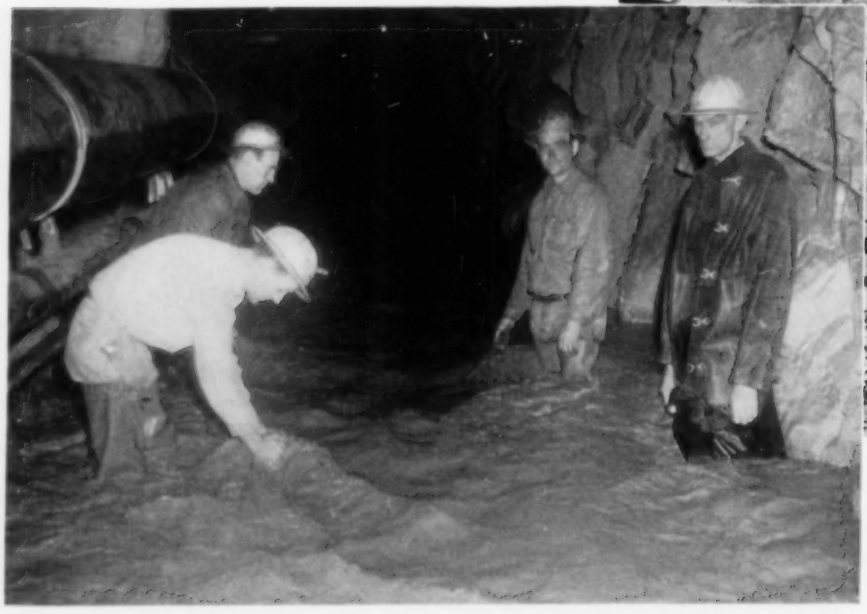
In the years ahead, one can confidently see an increasingly denser stream of traffic moving on the broad surface of the Trans-Canada Highway. Looking still further into the future, its importance looms even larger as it changes from a national to an international character upon becoming a branch of the Pan-American Highway sweeping down the Pacific Coast from Vancouver, on past Mexico City, and connecting with the road systems of South America. In addition it will be linked with the projected Alaskan Highway that may, eventually, be carried over Bering Strait to join the new network of roads being built by the Russian government, thus uniting the highways of the New World with those of the Old. But, for the time being, the completion of the Trans-Canada Highway is sufficient achievement.

Carlton Tunnel Taps Watercourse

C. H. Vivian

Photos by Thomas J. Barbre

THE Carlton Tunnel, which is being driven underneath the mineralized area at Cripple Creek, Colo., to drain water from the lower levels of its gold mines, reached its first objective on February 20, when it cut the New Market Fault of the Ajax Mine after having been driven 28,970 feet. The initial flow of water was 20,000 gpm. It increased temporarily to 25,000 gpm., fell back to 20,000 gpm. for a time, and then gradually decreased. The Ajax Mine, in which 500 feet of water had been standing, was drained to its lowest level in less than two weeks, and preparations are underway to resume working the property. Although the tapping of this watercourse was expected, the rapidity with which the Ajax was drained was gratifying to the officials of the Golden Cycle Corporation which has appropriated $1,000,000 for driving the bore as a means of reviving production from the deeper levels of the Cripple Creek mines. In addition to unwatering the Ajax, the tunnel has reduced the water level in the Portland appreciably, and that in the Cresson to a lesser extent, thus practically insuring the complete success of the venture upon the extension of the bore to its full projected length.



UNDERGROUND RIVER

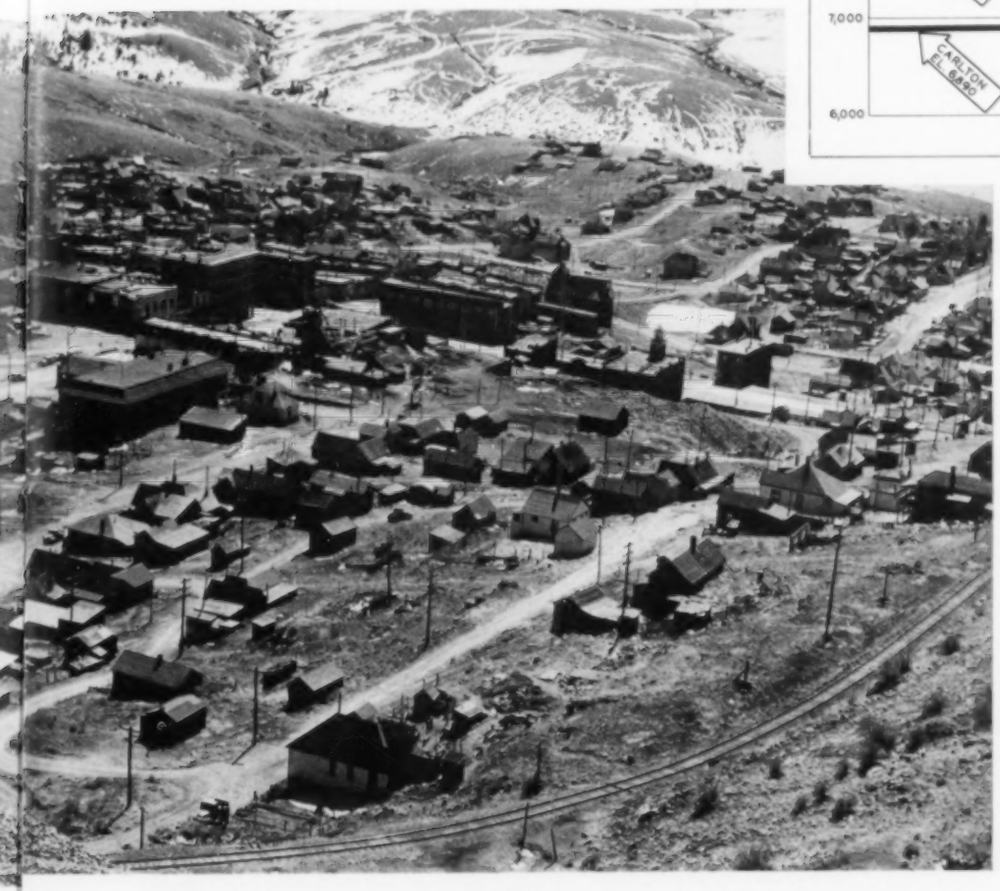
A view taken 1,000 feet back from the portal of the tunnel while the water was flowing at a rate of 20,000 gpm. In the ditches at the sides, where the men are standing, the water is between 2 and 3 feet deep, while in the center it is more than a foot above the tracks. Supt. John R. Austin is at the right.

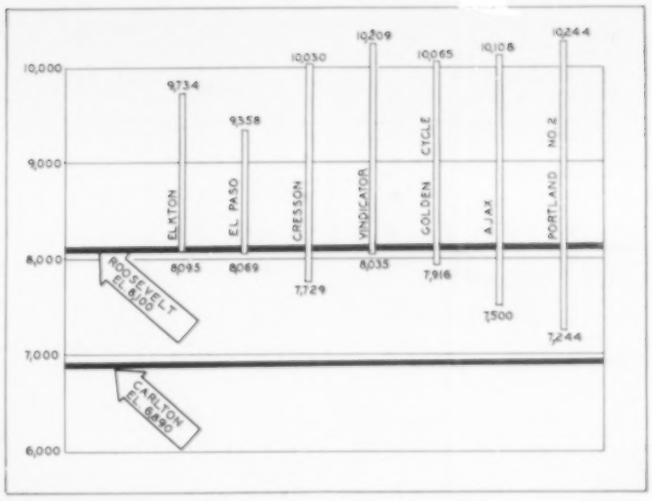
The influx from the New Market Fault filled the ditches on each side of the tunnel floor and overflowed the central haulage track to a depth of about a foot. Work had to be suspended for about three weeks, after which Supt. John R. Austin and his crews started cleaning up the bore. It was found impossible to get to the heading, however, so a crosscut was driven about 40 feet into the south wall and drilling resumed on a line parallel to the original tunnel. At the time of writing, March 20, the fault has not been cut on the new line; and it is hoped that, when reached, no serious trouble will be experienced in passing through it. For the present, owing to bad water and air conditions, work is being carried on in only two shifts daily. The water is heavily charged with carbon dioxide, which is given off when the pressure is released.

In accordance with the original plans, the tunnel will be driven an additional 3,030 feet to a point underneath the Portland No. 2 Shaft, a total distance from the portal of 32,000 feet. This will take approximately two months. It also has been definitely decided to extend the gallery to the Vindicator-Golden Cycle property and to carry a lateral to the Cresson, the leading producer in the camp for some

AJAX MINE AND CITY OF VICTOR

Surface buildings (left) of the first mine to be unwatered by the Carlton Tunnel. More than 500 feet of water that had been standing in its workings was drained in two weeks after the bore struck the New Market Fault on February 20. The Ajax, located near the Portland property, overlooks the City of Victor, pictured below. Its shaft is 2,608 feet deep, being bottomed about 525 feet above the Carlton Tunnel. The property is being made ready for the resumption of deep mining. The diagram (right) shows elevations of the shaft collars and bottoms of leading Cripple Creek mines in relation to the Roosevelt and Carlton tunnels. It will be noted that the new drainage bore will give them from 250 to 1,100 feet of virgin ground that can be mined before pumping of water is required. The cutting of two veins when the tunnel was nearing the Ajax would seem to indicate that all the mines will find ore throughout the added zone.





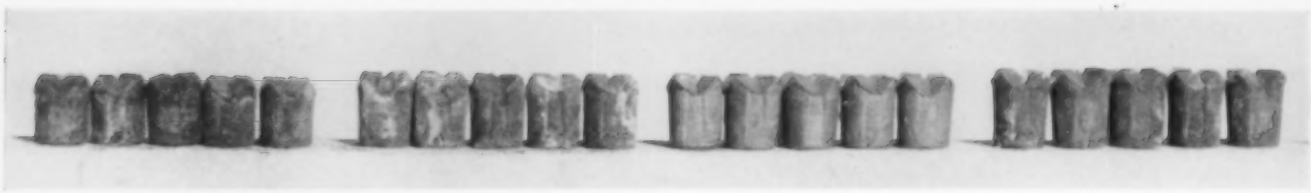
years past. Each of these objectives is more than 4,000 feet from the terminus of the main bore beneath the Portland No. 2 Shaft, and together they will entail about 9,000 feet of drilling.

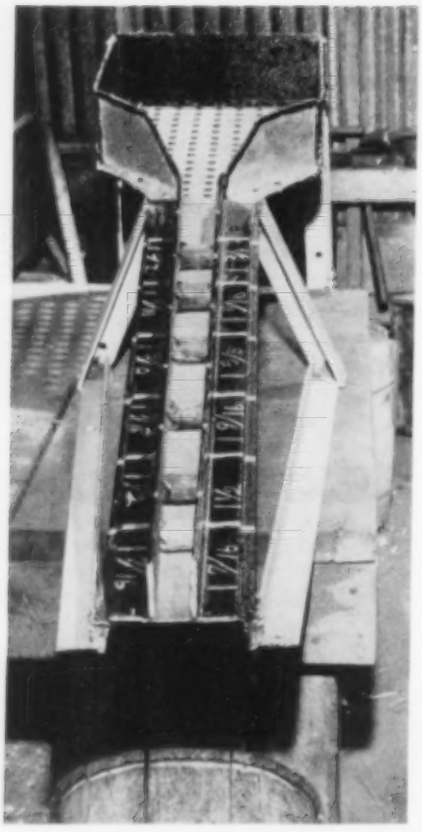
As was related in our June, 1940, issue, the Carlton Tunnel is the third drainage bore to be driven in the Cripple Creek District. The first one, the El Paso Tunnel, is half a mile long and intersects the El Paso Mine shaft at a depth of only 550 feet below its collar. It was completed in 1903, but twelve years after the first production of ore. The deeper mines had been pumping water since 1895, the cost of pumping rising proportionately with increased depth and seriously depreciating the mining profits. By 1905 there was imperative need of a deeper drainage gallery, and two years later the Roosevelt Tunnel was started after a fund of $1,000,000 had been raised to finance it. Its portal is situated several miles southeast of the mining area and at an elevation of 8,020 feet, which is 770 feet lower than the El Paso Tunnel. In 1910 it reached the brecciated zone of the old volcanic crater that is, in effect, a gigantic sponge encased in Pike's Peak granite. But the flow of water was small, and from time to time the bore was extended to provide drainage for the mines in various parts of the area. In 1918 it was at a point on the Portland property 24,255 feet in from the portal, and on January 1, 1919, a branch was completed to the Portland No. 2 Shaft, a distance of 2,131 feet.

The Roosevelt Tunnel prolonged production of the principal mines twenty years and more; but by 1930 several of the shafts had penetrated considerably below the level of the drainage gallery and it was necessary to pump water up to it in order to continue deep mining. Meanwhile, the cost of labor and mining supplies had risen and many mines were forced to shut down. By 1932 the value of the gold output had dropped to $2,262,967, the lowest since 1894. The increase in the price of gold in 1933 was a welcome stimulant, and since then Cripple Creek, Victor, and neighboring camps have gradually been shedding their ghostly shrouds. For the past several years production has been running around $5,000,000 annually, and the population of the district has been growing steadily.

Spurred on by this impetus, talk of a deeper drainage tunnel arose. It devolved upon the Golden Cycle Corporation to take action—this concern being dependent upon Cripple Creek ores for the operation of its concentrating mill at Colorado Springs and of the connecting railroad. Also, it has been the principal mine owner in the district for many years, having taken over the properties when their former owners could no longer make them pay. After the Golden Cycle Corporation had considered enlisting financial help from the Federal Government, it decided to defray the entire cost of the project itself. Work on the Carlton Tunnel was started on July 13, 1939. Its portal is located about 9 miles from Cripple Creek by road and at an elevation of 6,890 feet—1,130 feet lower than the Roosevelt Tunnel portal. The bore is being driven in a straight line and on a grade of three-tenths of one per cent toward the Portland No. 2 Shaft.

An accompanying diagram shows the depths of the principal mines in the camp and indicates how they will be benefited by the Carlton Tunnel. The deepest of them is the Portland No. 2, with a 3,027-foot shaft. Its lowest working level is at Elevation 7,244, or more than 850 feet below the Roosevelt Tunnel. The new bore will be about 200 feet beneath the latter's sump, permitting the shaft to be deepened that distance without the need of pumping. Moreover, much ore in the existing workings that has hitherto been inaccessible or too costly to mine because





JACKBIT SORTER

The establishment of a definite relationship between length and gauge of bits has made it possible to sort dulled ones into various sizes on the basis of length. This is done in the simple device shown at the left. The distance between the angle irons narrows gradually from top to bottom. Bits are rolled down the incline, and the point at which each is held fast discloses its gauge, as marked on the sides. Bits of the six sizes employed are shown at their respective stations. Those that have been worn down too short for further use pass through the opening at the end of the slot and are discarded. About 1,100 bits are dulled in the tunnel each day and are sorted the following morning by two men in half an hour. The bits in each of the groups above are of the same gauge. It will be noted that they are likewise of uniform height.

of the pumping involved can now be readily developed and recovered. In the other mines, greater intermediate stretches remain to be worked. The Cresson, which has produced $44,000,000, in round figures, has more than 700 feet to go before it reaches the level of the new drainage gallery, and the Elkton more than 1,000 feet. For nearly two years the output of all these mines has come only from levels above the Roosevelt Tunnel. Their pumps were pulled when work on the new bore was started so as to obviate the expense of operating them.

There is every reason to believe that the ore in these mines persists to the depth of the Carlton Tunnel. The vein system extends as far down as any shaft has penetrated, and geologists are of the opinion that the ore bodies will be found at levels considerably lower than those now opened up. The Carlton Tunnel has already confirmed this so far as the Ajax Mine is concerned, for two ore-bearing veins were cut by the bore when nearing the New Market Fault in which the water was encountered. When 28,215 feet in from the portal, a 3-foot-wide streak that samples $105 to the ton was intersected. Forty-five feet farther on was struck a narrower stringer, showing values of $66 to the ton. No development work has been done on them as yet, but some drifting will very likely be begun at both points while the remaining footage of the tunnel is being driven. It is thought that the New Market Vein is the richer of the two strikes. It has been extensively mined at higher levels in the Ajax, although it is not in the same vertical plane at the lowest level of the property.

Prior to reaching the New Market Fault, the greatest flow of water encountered in the Carlton Tunnel was 2,000 gpm., but this soon settled down to 800 gpm. The first evidence that the heading was approaching the fault was fractured rock. A round blasted at 8 a.m. on February 20 revealed bad ground, and square sets made up of 12x12-inch timbers were placed. Drilling and mucking were continued throughout the day, and the bore was actually several feet beyond the fault before the full flood of water came. The initial flow was about 800 gpm. and entered by way of the upper part of the tunnel. In the afternoon a stream about the size of a lead pencil began to issue from one of the walls. It was under great pressure, being of sufficient force to sweep aside a hand placed in it. A close watch was kept on it, and Superintendent Austin gave orders to make everything ready for immediate withdrawal from the workings. The rock drills were dismounted and placed on top of the drill carriage, muck cars were run out, and all miscellaneous equipment was gathered up. Around five o'clock the water began to gush up through the floor and to increase rapidly in volume. The order was then given to leave the tunnel, and the crew rode out on a man car drawn by an electric-storage-battery locomotive. The water flowed faster than the men were traveling, and by the time they reached the portal it was up to the motors, but they kept functioning.

The first attempt to inspect the bore was made three days later, when Superintendent Austin led a party of five into the tunnel. The water was still deep enough to run the danger of drowning out the motors on the locomotive, especially as the unit would raise a wave when advancing against the current. Accordingly, two locomotives were coupled together so that a spare one would be available if needed. It was known that some gas was coming into the bore with the water, so air was blown in through the regular ventilation line at the rate of 10,000 cfm. for 24 hours before the group entered, the blowers continuing to operate while the men were inside. No real hazard was believed to exist; but, as a precaution, Superintendent Austin gave instructions that, if they did not come out in an hour and a half, assistance should be sent in. In doing this, he unwittingly gave the mining district an exciting afternoon.

The party went in at 2 p.m. and made very slow progress because the condition of the track was not known. Every now and then stops had to be made to remove jams of ties, powder boxes, and other floating articles, and occasionally rocks had to be pushed out of the way. The air was none too good; but a safety lamp continued to burn, and the group kept moving ahead. Time passed quickly, and the instructions left outside were forgotten. Some concern was felt at the portal when the party did not return, and at 3:30 two men mounted a single motor and started in. As all obstructions had been cleared from the track they advanced with little difficulty, but gingerly. Meanwhile, the first group was well inside the bore and was attempting to get to the heading to observe its condition and to take photographs of the water flow. Some trouble with breathing was experienced; but eventually the "cherry picker" was reached. It was a few hundred feet from the breast. There a valve on the compressed-air line was opened, and, after inhaling the improved atmosphere and resting for a time, the advance was resumed. The men got to within about 100 feet of the heading; but from there on the floor of the tunnel was covered to a height of 6 feet or more with silt and boulders

that had washed out of the New Market Fault. It was then that they decided to go back.

In the interim the second party had made its way close enough to the first one to hear the five men sloshing around in the water and to ascertain that they were all right. With that knowledge, the two turned around and started for the portal, reaching it about six o'clock after having been in the bore for 2½ hours. There they learned that much had happened during their absence. When neither party emerged in a reasonable length of time, those outside became anxious for their safety and spread an alarm. Telephone calls were made to the Colorado Fuel & Iron Company plant in Pueblo and to Denver for first-aid equipment, and the Cripple Creek and Victor fire departments were summoned. A rescue squad was organized and entered the tunnel on the last-remaining locomotive. When the safety lamps went out after penetrating 4,400 feet, the members of this third group returned to the portal with the report that the air was very bad inside and expressed doubt that those who had preceded them could have survived in it. The steadily growing crowd allowed emotions to get the better of reasoning, and reports sifted out that the seven men were trapped. A Denver paper even printed an account that they were doomed. The tension was relieved when the second party appeared and gave assurance that the first group was in no danger. The five explorers emerged at 7:30, having been underground 5½ hours. They were little the worse for wear; but were greatly surprised to see the throng of people and to learn that they had been given up for lost.

By March 20 the flow in the tunnel had subsided to 7,800 gpm., and the water level in the Portland No. 2 Shaft was dropping at the rate of 2 feet a day and that in the Cresson 1 foot a day. Aside from lowering the water table in some of the mines, the flow through the Carlton Tunnel is of direct value to the farmers of the Arkansas Valley. Under an arrangement previously made it is being impounded in the Minnequa Reservoir near Pueblo for irrigation purposes. While the discharge amounted to 20,000 gpm. the water yielded a return of about $175 a day to the tunnel drivers. An even heavier flow is expected when the bore reaches the Portland No. 2 Shaft. The indications are that the rate of water subsidence in the Portland and the Cresson will increase to some extent while the remaining 3,030-foot section is being advanced, because the ground between those properties and the tunnel line is known to be fairly loose and fractured.

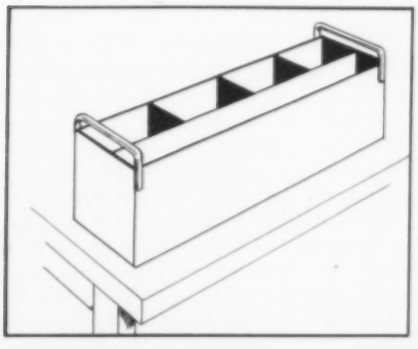
A. H. Bebee, general manager of the mines operated by the Golden Cycle Corporation and allied interests, predicted at the beginning of the activities that the Cresson would be unwatered slowly by the main tunnel, but that complete drainage would require driving a lateral to it. He also predicted that tight ground between the Portland and the Vindicator-Golden Cycle would prevent the latter properties from draining until the bore was extended to them. Carrying auxiliary galleries to the Cresson and to the Vindicator-Golden Cycle is of importance from the standpoint of mining as well as drainage, because by deepening the shafts and connecting them with the Carlton Tunnel those properties will be assured natural ventilation. Consideration is being given to driving a raise from the tunnel level to the present bottom of the Ajax Shaft while work on the final sections of the bore is underway. This would be an economical method of deepening the shaft and, if followed, would permit hauling the muck out through the tunnel and make it possible to use the full shaft-hoisting capacity for the handling of ore.

The New Market Fault was cut approximately nineteen months after tunneling was started. With only about two months' work remaining to reach the Portland No. 2 Shaft, it is assured that the entire main gallery will be finished in some 22 months, which is well under half the time estimated by the management when the venture was projected. Up to the time activities were temporarily halted by striking water, operations had been carried on for 567 days, and the average daily advance was 51.09 feet. This was an all-time record for a rock tunnel driven from one point of access. A statistical summary of the first five miles was published in our February issue, and a similar summary for the 5.487 miles to the New Market Fault will be found elsewhere in this article.

Analysis of the figures discloses some interesting facts regarding the drilling. The footage per day increased from 43.6 for the first mile to 48.9 for the second mile, to 55 for the third mile, and to 56.2

LOADING TUBES

For blasting in wet ground the powder is first loaded into metal tubes 10 feet long, the requisite number of sticks being used for the respective holes and the tubes being numbered for identification. One end of each tube is closed by a soldered cap. After the wire from the primer has been run out the open end, the latter is sealed with a Heitzman expansible plug, as shown here. The loaded tubes are then inserted in the drill holes and the wires connected for battery firing in the usual manner. In addition to saving an average of twenty minutes in loading a round of holes, the system makes for more effective blasting.



BIT TOTE BOX

Jackbits are transported in and out of the tunnel in metal boxes which can be loaded on a motor in a minute or less. Three are checked in and out with the nipper on each shift, and he must account for all that are sent in. The sketch shows the four compartments for the various sizes of sharp bits and the single long one in which dulled bits are placed. The boxes are 41 inches long, 10 inches wide, and 12 inches high.

for the fourth and fifth miles. The average time required to drill 1 foot (37 to 42 holes) dropped from 16.7 minutes during the first mile to a low of 12.5 minutes during the fourth mile, and averaged fifteen minutes for the entire 28,970 feet. All drilling was done with Ingersoll-Rand DA-35 power-feed drifters mounted on a drill carriage—five on the front end and two on the rear end for trimming the roof and for miscellaneous work. Eight drills were initially purchased and were used during the first year: eight additional machines were put in service last summer.

Aside from the uniformly good performance of the drifters, Superintendent Austin attributes the sustained, extraordinary drilling progress in part to Jackbits, the effectiveness and economy of which have been notably increased through the development of an improved system of handling and reconditioning them. The tunnel was started with conventional drill steel; detachable bits were adopted in the second month; and since March, 1940, Jackbits have been used exclusively. For a time the hot-milling equipment for reconditioning them was stationed at the Cresson Mine, and bits and rods were transported between that point and the tunnel. Today, however, this equipment is located at the tunnel where the technique now practiced was evolved under the supervision of Master Mechanic Robert W. Welch. Its success may be judged from the fact that bits are milled seven times at a cost of 2.2 cents for each milling. An average of 1,100 bits is dulled each day and that number is milled daily by two men on an 8-hour shift. They have handled as many as 1,512 bits in that period, or an average of nearly 200 an hour. Hardening is done during a second shift.

New bits are all of 1¾-inch gauge and are a Type 1 special model developed for service in the iron mines of the Great Lakes region. The Jackrods are of 1¼-inch hollow, round section, the threaded ends being turned down to the diameter required to take the relatively small bits. Four bits are used for each hole, the sequence in Jackrod lengths being 3, 5, 7, and 9 feet. All holes are bottomed with bits of 1$^{7}/_{16}$-inch gauge, which is a drop of only $^{5}/_{16}$ inch from the new bits. As the bits are milled an average of seven times it will be apparent that they are not materially reduced in gauge every time they are milled. In fact, the Pikes Peak granite is but slightly abrasive, with the result that there is little wear on the outer faces of the bits, especially as new bits have a 0° taper for $^{5}/_{16}$ inch back of the cutting edges. Accordingly, with only light milling, the gauge can be held practically at its previous dimension, and this is done, when desired, at the first three millings.

RECONDITIONING JACKBITS

These two men, using an Ingersoll-Rand Jackfurnace and Jackmill, regularly mill 1,100 bits during one shift.

To get a maximum of service from bits, three sizes of starters are employed: 1¾-inch, 1$^{11}/_{16}$-inch, and 1⅝-inch. Where a new bit of 1¾-inch gauge is used, it is followed successively by 1$^{11}/_{16}$-, 1$^{9}/_{16}$-, and 1$^{7}/_{16}$-inch sizes. A 1$^{11}/_{16}$- or a 1⅝-inch starter is followed, in turn, by 1$^{9}/_{16}$-, 1½-, and 1$^{7}/_{16}$-inch bits. In all cases, the starters may be milled twice without noticeable loss of gauge. This system gives rise to great flexibility and insures utilizing all new bits to their fullest extent before they are discarded. Under the old practice new bits were milled a maximum of five times and were thrown away even though much usable metal remained on their cutting ends.

The basis of the system, which is made possible by reason of the drilling characteristics of the rock, is sorting used bits according to length instead of gauge alone, as is the usual procedure. The simple device employed for this purpose is pictured elsewhere. It consists of two pieces of angle iron welded on a flat base. At the upper ends, the pieces are slightly more than 2⅛ inches apart, this being the length of a new bit. The gap at the lower ends is 1½ inches, which is the length of a bit that has been milled down until little if any usable metal is left to form the required cutting edges. The intermediate space of the sorter narrows gradually and is divided into sections, each about 6 inches long and marked on the sides. The widths of these sections conform to the lengths of the varying gauges of bits used. This sorter is set up on a slight slope, and when the dull bits come from the tunnel they are rolled down between the angle irons, one at a

CRESSON MINE

Although no ore was mined on its three deepest levels during 1940 because of water, the Cresson retained its rank as Colorado's leading gold producer with an output of $1,165,000. This brought its all-time production to $43,816,121, of which $13,381,672 represents dividends paid. A lateral will be driven from the Carlton Tunnel to a point underneath its shaft, after which the latter will be deepened 700 feet to connect with the drainage gallery.

time. The gauge of each is disclosed by the section in which it is held. One man feeds the bits and another takes them out and places them in barrels marked with their respective sizes. With this device, the 1,100 dull bits from 24 hours of drilling are sorted each morning in half an hour.

Another time saver is the practice of milling only one size of bit each day. This eliminates the need of making changes in the milling equipment and consequently increases the number of bits that can be reconditioned during a shift. Bits are sent into the tunnel at the beginning of each shift in specially made metal boxes each of which has four compartments for sharp bits—one for each size—and one compartment into which the dull ones are placed when they are taken off the rods at the drill carriage. These boxes are numbered for easy identification, the contents being checked with the nipper when they go into the bore and again when they come out. Since this system has been placed in operation, bit loss has been almost negligible.

At the outset of the operations, holes were started with 2⅛-inch bits. According to Superintendent Austin, the reduction to 1¾-inch starters has resulted in a saving of 26 per cent in drilling time, while refinements in the handling and reconditioning of bits have added a further saving of 6 per cent, making an over-all increase in drilling speed of 32 per cent. "We have found," he states, "that we can pull the ground better with the small holes than with the large ones and without increasing the number of holes to a round."

SUMMARY OF OPERATIONS TO FEBRUARY 20

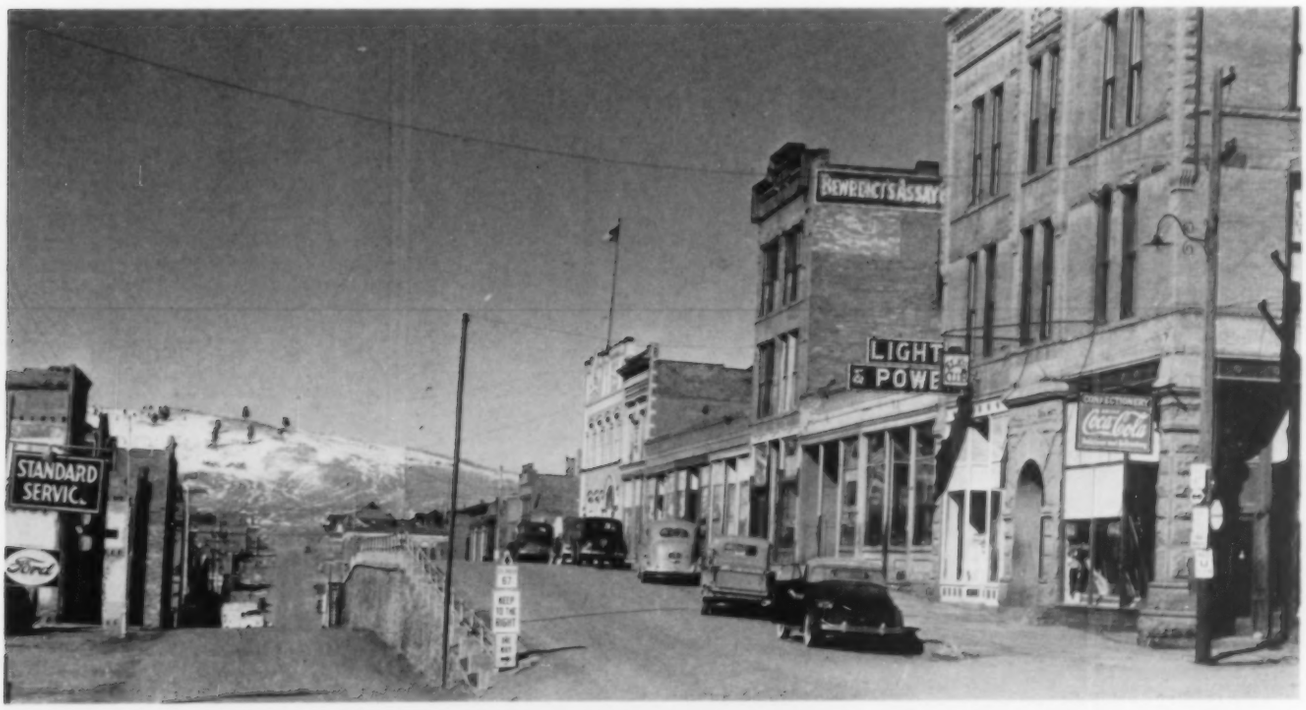
Distance driven, feet	28,970
Time timbering, hours	160½
Time drilling, hours	7,240¾
Time mucking, hours	6,206¾
Cubic yards excavated	109,792
Cars mucked	53,219
Powder used, pounds	951,280
Powder per foot, pounds	32.84
Caps used	145,431
Caps per foot	5.02
Total rounds	4,023.93
Footage per round	7.20
Total working days	567
Average daily footage	51.09

As the drilling crews receive a bonus for every foot of advance over 10 feet per shift, figured on a monthly basis, the men are eager to try out any new ideas or methods that give promise of increasing the footage. The bonus system has removed the necessity for bossing, Mr. Austin says. In a trained crew, each man is always looking for a chance to speed up work by helping his fellows, and all lend a hand freely wherever it will save time for the operation as a whole. The miners are averaging $8 a day in wages and bonus, or approximately 70 per cent more than the prevailing day's pay in the mines of the district. The tunnel workers are young men of good physique and the labor turnover is small.

An innovation in blasting methods that has increased the length of a round pulled in wet ground is the use of metal loading tubes, which are shown in an accompanying illustration. They are formed of 30-gauge galvanized sheet by crimping, have an inside diameter of 1¼ inches, and are 10 feet long. One end is closed by a soldered cap. These tubes are loaded with fifteen to eighteen sticks of du Pont 40 per cent semigelatin dynamite and a primer. The wire from the latter is run out of the open end, which is then closed with a Heitzman expansible rubber plug. The fully loaded tubes are inserted in the drill holes, and the wires are connected up and fired by a battery in the usual manner. Mr. Austin reports that their use saves about twenty minutes in loading a round in wet ground, or a total of well over two hours a day. A further benefit is the insurance that a full round will be pulled, something that is seldom achieved by loading directly into the holes. The tubes are not used in dry ground.

An additional minor time saving at the heading has been made by equipping the drill carriage with two oilers for each drill instead of one, as was previously the practice. When one container is empty the second one is turned on. This obviates replenishing the oil supply while drilling is in progress and assures adequate lubrication for the drifters at all times.

The Carlton Tunnel operation of the Golden Cycle Corporation is being carried on under the direction of A. H. Bebee, manager of mines, with John R. Austin as superintendent. J. G. Farmer is engineer and R. W. Welch is master mechanic. L. Stiles is night foreman, and the shift bosses are A. Stiles, C. Swartz, and R. Brewer.



CRIPPLE CREEK'S DIVIDED MAIN STREET

A part of the main thoroughfare traverses a hillside of such steepness that the street had to be separated into two traffic lanes at different levels. Hundreds of buildings in the town were torn down after the World War, and now, with a measure of prosperity in the camp, unoccupied houses are relatively scarce.

WALLACE IN 1888 AND NOW

Wallace (below) is the county seat of Shoshone County and the largest trading center in the Coeur d'Alene mining district. It is situated on the Coeur d'Alene River at an altitude of 2,733 feet. It was first settled in 1884 and was incorporated in 1892. The view at the left shows it as it appeared in 1888.

Evolution of a Mining District

H. W. Ingalls

THE Coeur d'Alene mining district in the Panhandle of northern Idaho is recognized as one of the richest mineralized areas in the world, occupying about the same position in the silver-lead world as Butte holds in the copper world. Idaho is listed in the Minerals Year Book of the U. S. Bureau of Mines as the nation's largest silver-producing state and second-largest lead-producing state, being surpassed only by Missouri. More than 90 per cent of Idaho's silver and lead output comes from the Coeur d'Alene District, which is perhaps one of the most picturesque mining camps in the world. Situated among forest-clad mountains which rise to elevations as high as 7,000 feet, this 30-mile-square area has a habitation level of from 2,000 to 3,100 feet above sea level and, as a rule, enjoys mild winters and cool summers. During the last two years—1939 and 1940—the district has reveled in a climate equal to southern Arizona or California.

As evidence of the camp's great mineral wealth one has only to look at the dividend record of the Coeur d'Alene mines. As closely as can be determined from authentic records, a total of $173,484,804 has gone to stockholders in the mining companies in the last 54 years—1886 to 1940. This great sum of money is probably less than one-fourth of the wealth taken out of the Coeur d'Alene mountains: the balance of it represents actual wages paid to miners and expenditures involving lumbermen, machinery manufacturers, powder factories, and in fact every industry supplying the needs of man. Compressed-air machinery is one of the important items on the expense list of all the mining companies, big and little, for compressed air is the very life of the industry. Huge compressors driven by electric power furnish air for operating drills, mine hoists, and numerous other pneumatic tools and equipment.

Mining money goes into every nook and cranny of the business world, and it is received in cash, not in trade dollars. A large part of that from the Coeur d'Alene is in silver—new money, new additions to the world's cash treasure. It also adds to the wealth of the Government, because the latter deducts 57.89 cents as a seignoirage charge from every ounce of silver produced. Out of every ounce obtained in

the Coeur d'Alenes, or anywhere in the United States, the miner gets 71.11 cents and the Government a profit of 57.89 cents because it issues paper silver certificates against the silver bullion on the basis of $1.29 an ounce for the metal.

The Coeur d'Alene mining district started out as a wilderness—an uncharted and inaccessible wilderness except to a man on foot, a country composed of nothing but gigantic mountains, rushing streams, and heavy timber. Into this unknown area came the pioneer, that intrepid soul that blazes the trail for civilization, whether he be farmer, prospector, or adventurer. In this instance it was the prospector. Where he hailed from, and how he happened to get into this part of the then Wild West, are as much a mystery as how he came to be a prospector in the first place. His name was A. J. Prichard. He discovered gold on Prichard Creek, and that set the ball rolling. About all that Prichard ever got out of it is that his name still clings to the creek. That is the fate of the majority of pioneers: they gain little for themselves, but their efforts result in inestimable benefits to posterity.

How the story of a gold strike travels nobody knows; but it travels somehow on the wings of the wind and brings back a whirlwind of adventurers—people from all walks of life—in its wake. Prichard's gold discovery attracted other pioneer prospectors who, failing to get what they wanted on Prichard Creek, ventured farther into the wilderness and found the old prehistoric river-gravel bench placers at Murray. As these were worked and waned, other adventurous souls uncovered and developed rich lode deposits in the Daddy, Mother Lode, and Golden Chest mines. All could not share in these limited gold discoveries, and less fortunate prospectors were compelled by force of circumstances to explore new territory. One of these was Noah Kellogg, an individual who had an urge to go places and nothing to go with. He probably figured that anywhere he might go could be no worse than where he was, so he talked Cooper and Peck, general-store merchants, into giving him a "grubstake" to go prospecting. They furnished him with a burro and the proverbial slab of bacon and sack of flour on which all old hard-boiled prospectors are supposed to subsist until they strike it rich.

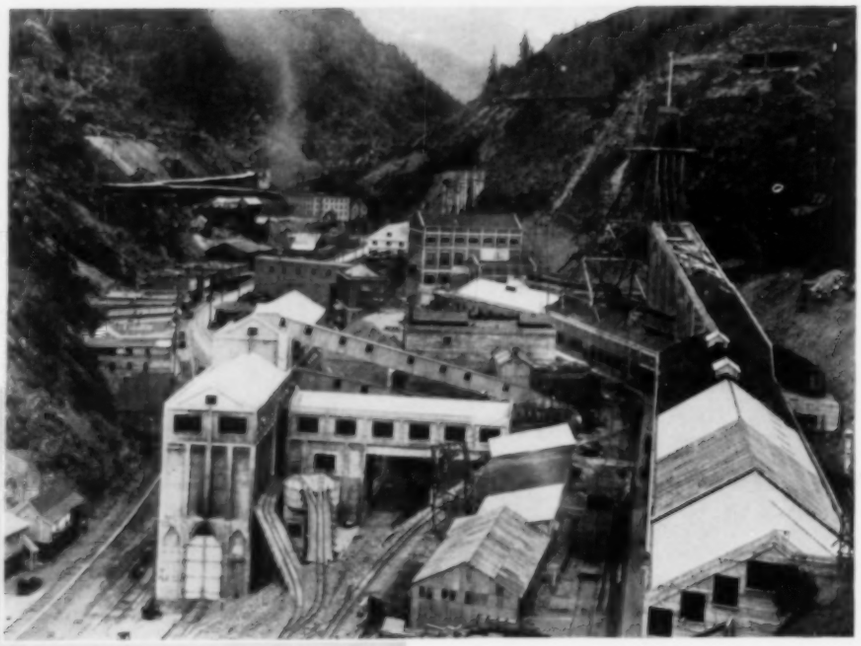
Kellogg set out with his donkey and groceries. He had no more idea where he was going than the donkey had, and probably headed down river because it was easier traveling that way. He camped one night in a canyon near a small stream of cold, clear water, just because it was a handy place and because darkness overtook him there. He turned the animal loose to rustle its own feed. It was in the fall of the year, and in the mountains the nights were cold. In the morning the ground about Kellogg's camp was covered with heavy frost. Kellogg prepared his coffee and frying-pan-bread-and-bacon

SUNSHINE MINE AND MORNING MILL

The Sunshine Mine (left) is the nation's largest silver producer (9,414,514 ounces in 1939). From it comes more than half of the silver output of Idaho. It gave little promise when taken over by John Sawbridge in 1920, and in 1923 an assessment was made against the stockholders to raise funds to carry on. Since 1926 it has paid $20,367,075 in dividends. Its shaft descends 3,700 feet, or 1,000 feet below sea level. The Morning Mine plant (above) is at Mullan and yields around 1,000 tons a day through a shaft that is 4,450 feet deep. The property was bought by the Federal Mining & Smelting Company about 1912 for $3,000,000 and has since made net profits of more than eight times that sum.

BUNKER HILL SMELTER AND HECLA MINE

The Bunker Hill Smelter (below) at Kellogg, treats ores from the Bunker Hill Mine and also does a custom business. Surface buildings of the Hecla Mine at Burke (right) are all of steel construction. The mine produces through a shaft 3,600 feet deep. It has paid dividends of nearly $24,000,000. At the left are business houses in Burke. The tracks of the Northern Pacific Railroad follow the town's winding main street.



breakfast shivering over a campfire, and then started to look for the donkey. He finally saw him grazing high up on a mountain forming one of the canyon walls. Up there the sun was shining. Kellogg climbed up to get the animal and discovered "float" mineral scattered over the hillside. He followed it along until he came to the outcrop of what has since developed into the Bunker Hill, one of the greatest lead-silver-zinc mines on the North American Continent.

The story of Noah Kellogg and his jackass will never die in mining history. Most writers like to feature the idea that the donkey found the mine; but even Kellogg did not know that he had discovered one. He did know that he had stumbled upon mineral of some kind, so he put up a location notice, collected samples of the ore, and headed back for Murray. Other prospectors in the camp, with more experience, recognized the ore as "galena," a sulphide of lead; and in that way was born the first mine in the district that has produced millions in wealth and is recognized as one of the richest mineralized areas in the West. Bunker Hill has so far paid $54,938,018 in dividends.

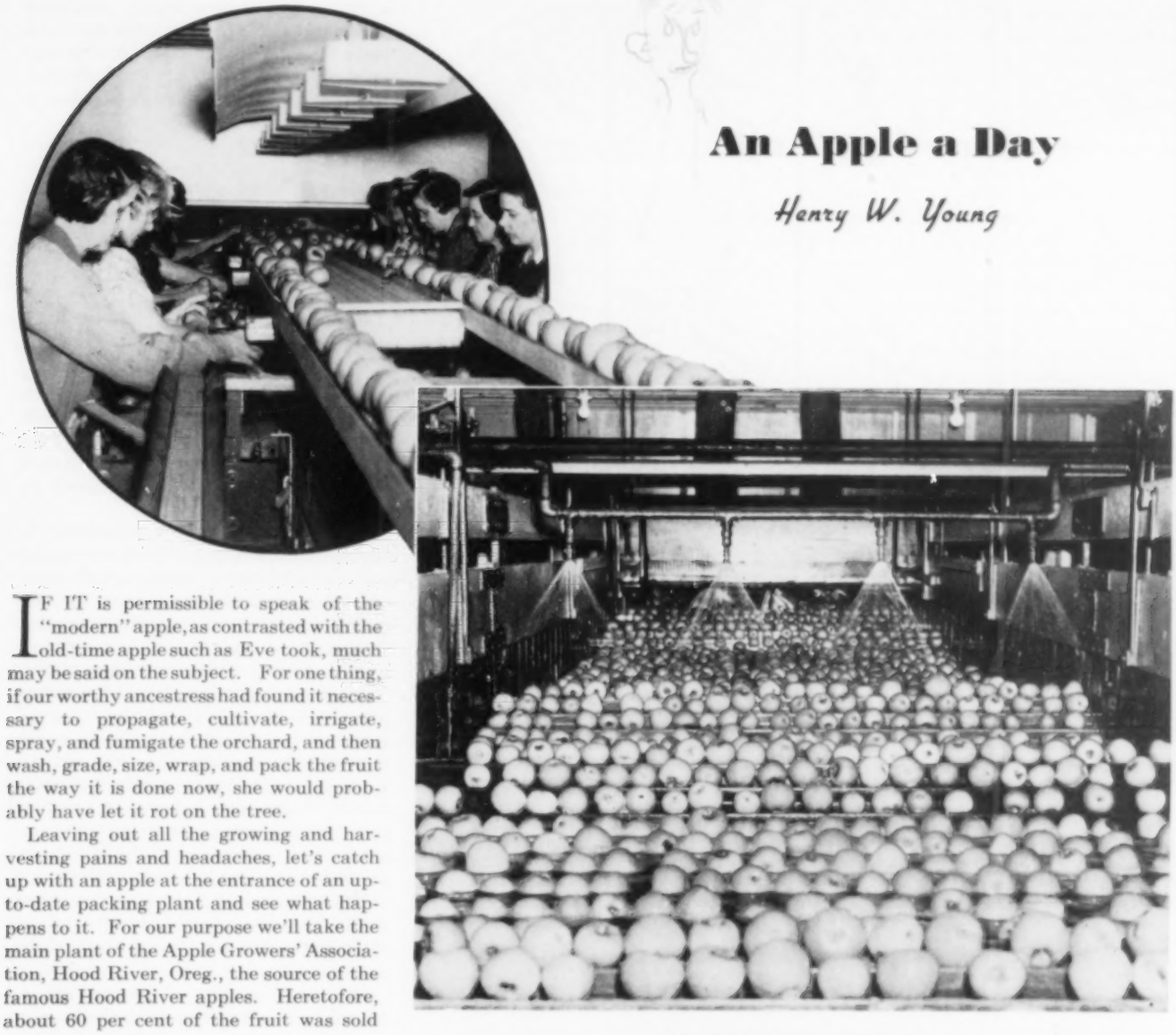
Still other gold seekers branched out and, following up the south fork of the Coeur d'Alene River from Kellogg's strike, soon found and named the Tiger and Poorman mines in what is now Canyon Creek or the Burke Canyon, one of the most productive canyons in all mining history. Farther up the main river, at the present Town of Mullan, were located the Morning, You Like, and Hunter mines, all of which have been worked steadily for 50 years and are still many years short of exhaustion. The Morning Mine output alone has amounted to $26,109,600 since 1886. Mullan was named for Capt. John Mullan, who built the first military trail across the country. It connected Fort Benton, Mont., with Fort Walla Walla, Wash. Captain Mullan and his soldiers camped for several weeks at the site which has since become known as Mullan; and so it happened that a mining camp that now has a population of 3,000 was named in his honor.

Other big producing mines in the district were discovered later with deeper development work, and the Coeur d'Alenes gradually grew into mining-world importance until the depression of 1929 brought an end to prosperity and industrial activity of all kinds. Then the camp experienced a period of "hard times" such as no one would ever have predicted or thought possible. But prospectors thrive on hard times. An enterprising stockbroker organized a "wildcat," which he named the Sunshine Mine, and sold the "lemon" to John Sawbridge, a retired plumber and apple grower in Yakima, Wash., who knew as much about mining as the average miner knows about plumbing or apple growing. Today the Coeur d'Alene District owes John Sawbridge an everlasting debt of gratitude and should erect a monument to his memory, because out of this "wildcat" he started the greatest and richest silver mine in the United States and paved the way for the development of what promises to be the most important silver-mining camp in all history. Up to the present time, or within a period of fourteen years, the Sunshine has paid $20,367,075 to its stockholders in dividends. Because of this sensational discovery, four other rich silver producers—the Crescent, Polaris, Coeur d'Alene Mines, and Silver Dollar—have started operations. Many others are in the prospect stage, and perhaps others remain to be discovered.

During the years of mine development, the Coeur d'Alene District has grown from a half dozen rough-and-ready mining camps to as many modern and thriving little cities with paved streets and connecting paved highways and with business houses and mercantile facilities that compare favorably with the best in the West. Nowhere else in the East or West will you find beautiful scenery coupled with great mineral wealth, plus modern communities—all set in lush green forests teeming with game and mountain torrents alive with fish—within a day's reach by automobile.

An Apple a Day

Henry W. Young



IF IT is permissible to speak of the "modern" apple, as contrasted with the old-time apple such as Eve took, much may be said on the subject. For one thing, if our worthy ancestress had found it necessary to propagate, cultivate, irrigate, spray, and fumigate the orchard, and then wash, grade, size, wrap, and pack the fruit the way it is done now, she would probably have let it rot on the tree.

Leaving out all the growing and harvesting pains and headaches, let's catch up with an apple at the entrance of an up-to-date packing plant and see what happens to it. For our purpose we'll take the main plant of the Apple Growers' Association, Hood River, Oreg., the source of the famous Hood River apples. Heretofore, about 60 per cent of the fruit was sold abroad every year, particularly in England, Central Europe, and the Mediterranean countries; but that market has been blotted out. This is a serious problem, particularly in the West in such great apple districts as the Hood River Valley, the Yakima and Wenatchee in Washington, the Payette in Idaho, and the Watsonville in California, where the export business has always been a major factor. But these growers are not taking it lying down, and are out to make us more apple conscious—to increase domestic consumption.

WASHING AND SORTING

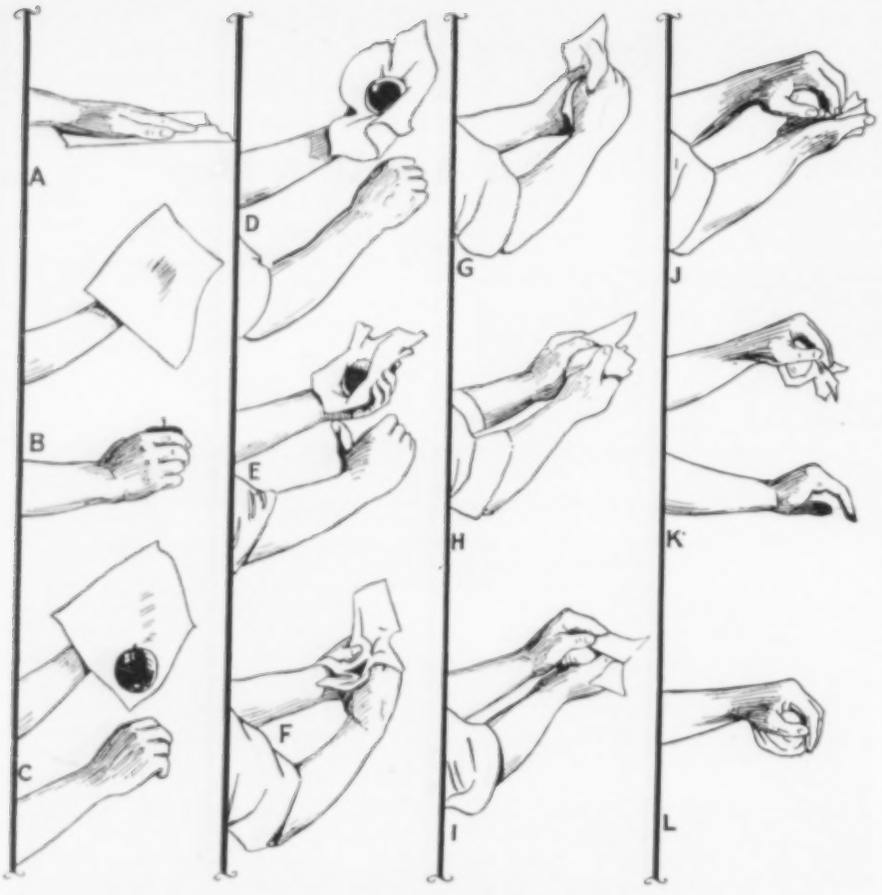
Upon entering the plant, the apples are washed thoroughly with slightly acid water to remove the residue of spray solutions applied during the growing season. They then pass along a sorting table, one type of which is shown at the left. The top-grade fruit is on the lower belt and the other grades are on the upper ones, all being on their way to an automatic sizing mechanism.

SORTING ROLLS

Plan drawing showing details of spirally wound sorting rolls the rotation of which moves the apples along, meanwhile turning them over repeatedly so that all their surfaces are visible to the inspectors. Defective and off-color fruit is picked from the rolls. Grade A apples remain on to the end, where they are deflected on to the feed belt without having been touched by hands.

Grading and sizing the fruit is done by a continuous, mass-production process that is about as ingenious and efficient as the assembly line of an automobile factory. When you open a box of fancy apples and discover that all of them are of the same size and of the same coloring, so far as the eye can detect, remember that the fruit was not packed out under the tree on which it grew. Many things have been done to it by mechanical means that are as interesting as anything to be found in the industrial world. The apples that are delivered to the packing plant are "run of the orchard." They are of all sizes and shades, depending on the variety and the amount of sunlight they have received; some are specked and blemished; and all bear traces of the solutions with which they have been sprayed as a protection against insect pests, etc. These must be washed off down to the minute quantity specified by law.

Washing and drying, grading, sizing, and packing are the four steps in processing apples. While the actual handling is



WRAPPING AN APPLE IN TWELVE MOTIONS

This sequence was worked out by the U.S. Department of Agriculture to save unnecessary motions and to reduce contact of fruit with hands to a minimum. Using it, the average worker can pack from 100 to 120 boxes of machine-sorted fruit a day—a box every four or five minutes. Key to the operations: A—Picking up the wrap; B—picking up the apple; C—throwing the apple into the wrap; D—position of the apple upon striking the wrap; E—wrapping process, first stage; F—wrapping process, second stage; G—apple held tight in right hand, pressing it against cup formed by the left hand; H—turning apple within cup formed by the left hand, both wrists turning toward the right; I—hands turning over completely; J—back of left hand upward, back of right hand downward; K—apple ready for placing in box, right hand reaching for next apple; L—placing wrapped apple in box.

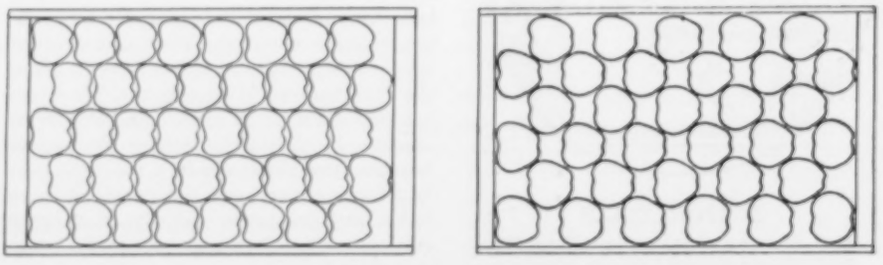
done largely by machinery, the human element enters into it at a number of important points. Watching the pieces of fruit go down the line, one cannot help but recall Omar Khayyam's admonition of "Gently, Brother, gently, please." Everywhere there are divergences in the path of travel, changes of grade and speed, shock absorbers, buffers, fabrics, aprons—a score of devices to prevent shock and bruising. If an apple has the slightest imperfection or indentation it is degraded and sent to the vinegar plant or cannery. There are conveyors everywhere, both gravity and belt—in fact, from 10 to 12 miles of them are in service in the several establishments of the Hood River Apple Growers' Association.

The accompanying photographs are reproduced through the courtesy of the Cutler Manufacturing Company, which recently consolidated with and is today known as the Bean-Cutler Division of the Food Machinery Corporation of San Diego, Calif. A large percentage of the equipment in the plant we are visiting was manufactured by that concern and is a far cry from the first crude wooden graders designed and constructed by the Cutler brothers, Frank W. and Asa B., back in 1912. The present highly developed system is now used in all parts of the world where there are large fruit-growing districts, and is suitable for pears, tomatoes, citrus fruits, and even such produce as potatoes.

The units for grading and sizing range from small, one-sided, single-grade outfits to multiple systems that are served from two sides and are capable of handling numerous grades and sizes. They are generally interchangeable; and the packing-house operator builds up his plant by adding units as business warrants. After washing comes the work of grading, which starts at a mechanical sorting table. If it is of the double type, imagine pairs of long wooden rolls extending lengthwise on each side. These rolls are wound with sash cord, spiral fashion. In the middle of the table is a conveyor belt to receive the culls from the sorters that are stationed on both sides.

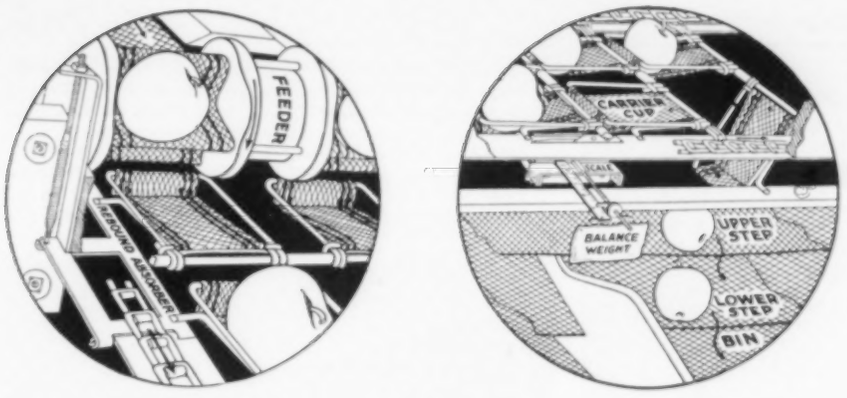
The apples are gently transferred to the rolls from a hopper. They are caught and carried forward by the spiral cords, which have a screw action when the rolls revolve. As the latter turn, they also cause the apples to turn so that, during their passage down the table, every face of each one is presented to the view of the sorters who spot blemished and light-colored fruit and place it on the cull belt, which moves in the opposite direction. At the discharge end of the rolls only first-grade apples remain to be deflected on to a feed belt, which conveys them to an automatic sizer. However, if fruit is to be divided into several grades, there are tables provided with two or three feed belts. These are above the center of the table and within convenient reach of the sorters.

In operation, most of the culls are removed by the worker next to the hopper. The second sorter picks out most of the remaining apples that are below first grade, and the third one makes a final inspection, leaving the choice fruit to be diverted from the rolls to the feed belt. The equipment used is generally of the class just described, as it is best suited for all-around service. But for some products that require different handling, a wide,



STANDARD APPLE PACKS

Here are two of the 27 standard ways of packing a box of apples. The one at the left is the 3-2 wide and 8-8 long style. This means that the transverse rows contain three and two apples alternately and the longitudinal rows eight each. There are five layers or 200 apples in the box. At the right is shown the largest of the 3-3 packs. It has three apples in each crosswise row and six and five alternately in those running lengthwise. The box holds 198 apples in six layers.



SIZING MECHANISM

Weighing has been found to be the most satisfactory method of sizing apples. Each is carried along in a fabric cup and passes over a series of weighted scale beams. When it reaches one that it overbalances, it depresses the scale arm, the cup is tripped, and the apple falls on to the first of a series of webbed steps. It is then delivered by gravity to a bin, rolling gently and being protected against bruising.

central belt may be substituted for the spirally wound rolls for carrying them and from which the sorters can pick or cull as it travels along. When rolls are employed, they can be set instantly to revolve at any one of four speeds. The cleaner the apples, the more rapid their progress, the head sorter determining and adjusting the rate of speed accordingly. The capacity of a double table, under average conditions and where two or more grades are being selected, ranges from 800 to 1,800 bushels a day. The more difficult the work, the greater the number of sorters at each table.

It is the first-grade fruit we will follow through the plant. It is free of specks or blemishes and of uniform coloring. The next stage in the operation is sizing. Putting apples of practically the same size in a box, is just another way of making the package more attractive and helps to promote the sale of fancy brands. Lying on the feed belt running from the sorting table, the apples reach the automatic sizing machine which, regardless of the shape of the fruit, performs its several functions with more than human precision. Sizing is done by weight, which has been found to be the most satisfactory method and is suitable for handling other products such as peaches, pears, tomatoes, citrus fruit, and the like. The stream can be separated into as many or as few sizes as desired, and no hand touches the fruit as it moves along.

From the feed belt the apples are transferred to a sizing carrier, which consists of two chains with a series of cross rods. Hinged to each rod is a cup that is made of rigid spring steel and webbing—the fruit coming in contact only with the fabric. Each cup receives one apple, and as it advances it is held in a horizontal position by a finger projecting sidewise and bearing on a rail paralleling the chains. This is what is known as the "main rail" of the sizer. Alongside the latter there is a succession of balanced scale beams and a long row of circular open-top bins—one for each of the scales which control the delivery of fruit to the respective bins. The inner end of each scale bar fills a gap in the main rail, and the outer end carries an adjustable weight.

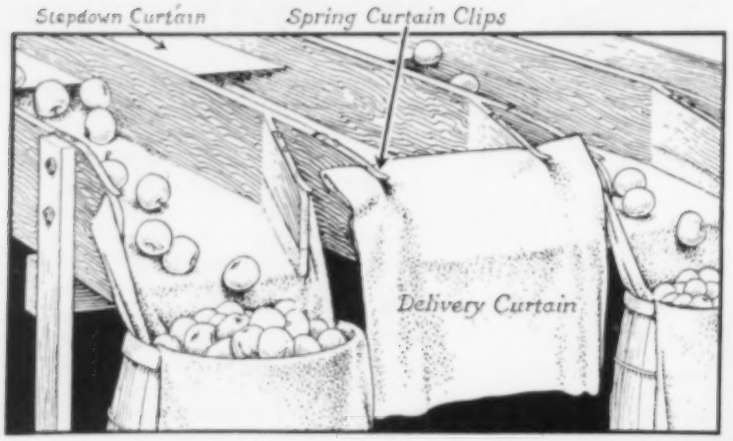
As a laden cup moves forward, its finger passes over the inner ends of the scale beams, which serve as supports and enable it to cross the gaps. But when the finger reaches a scale that is so adjusted that the weight of the apple in the cup overbalances that of the scale, then the finger falls into the gap, the cup is tripped, and the apple rolls out—the finger, for the remainder of the distance, resting on a continuous rail below the main rail. The cup is arranged to swing downward slowly and to deposit its load carefully on a webbing step. From there it rolls to a lower step and then into the bin. The whole transfer is effected gently, and there is not the slightest danger of bruising the fruit.

The bins used are hinged to the sizing carrier and are spring supported on the opposite side. As apples accumulate in a bin, their weight depresses it, so that the fruit inside of it remains at a well-nigh constant level. The worker who stands alongside can therefore pack it in boxes with a minimum of stooping or movement of hands. Sometimes the apples are not hand packed but are run directly into barrels, or they may go into a different type of circular, rotary bin before being put in boxes ready for the cold-storage warehouse and shipment. In such cases, canvas curtains or baffles serve as shock absorbers and permit the fruit virtually to "flow" to its final resting place without bruising.

The size delivered to any one bin may be altered by adjusting the balance-weight thumbscrew, a visible record of the scale setting making it possible to change from

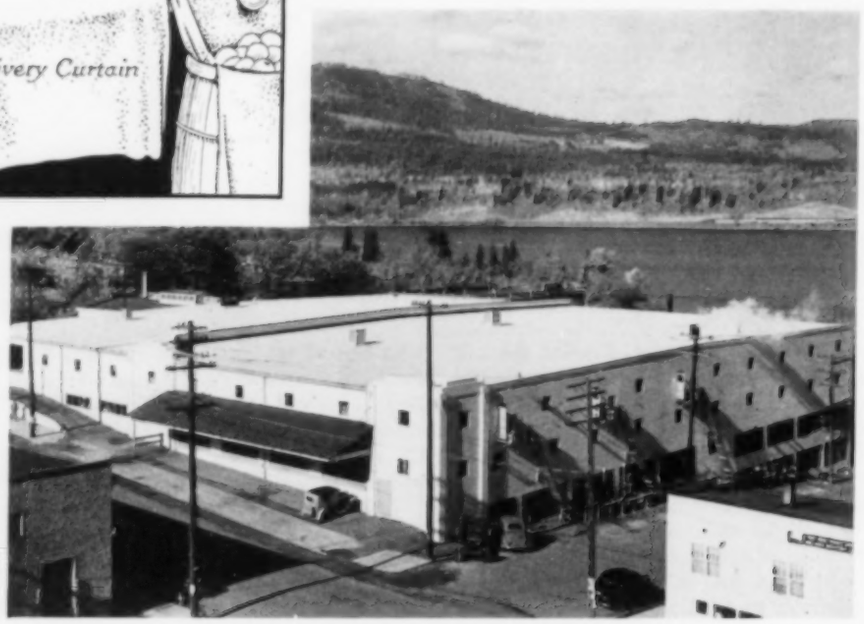
AUTOMATIC SIZER

The apples are carried along in the canvas cups shown at the left. They are sized by weight, each of the various sizes being delivered into a bin from which they are packed into boxes for shipment. Because of the way the cylindrical bins are supported and hinged to the sizing carrier, the fruit in them remains at a fairly constant level and can be reached with a minimum of stooping.



PACKING IN BARRELS

When apples are packed directly into a barrel they pass downward over a series of padded steps and are slowed by canvas curtains or baffles that prevent bruising.



APPLE-PACKING PLANT

The Hood River Growers' Association has invested more than $1,000,000 in processing plants and equipment. Last year 1,700,000 boxes of apples were packed and shipped. Pictured here is the principal packing plant and warehouse situated on the Columbia River near the point where the Hood River enters it.

one to another without loss of time. While sizing is done by weight, the consumer gauges the size with his eye. He may be buying the largest Grade A apple of one variety that weighs, say, 10 to 12 ounces, while that of another weighs 8 to 10 ounces.

Not until after the apples are in the bins are they actually handled. They are removed by the packers and placed in boxes, either wrapped or unwrapped, by numerical count. To do the wrapping quickly without injury to the fruit takes skill acquired by practicing a routine that has been worked out to a nicety and that requires twelve movements on the part of both hands. This routine is shown in a series of sketches that was prepared by the U.S. Department of Agriculture.

The art of packing by numerical count is not difficult if certain simple rules are mastered in the beginning, especially as the apples are sized so accurately by the weight system. The standard apple box is 10½x11½x18 inches, inside measurement. Years of experimenting with different styles of packing have resulted in the general adoption of the so-called "diagonal" pack. There are 27 standard apple packs, ranging from 2-1 wide and 4-4 long in three layers and 36 to the box to 3-3 wide by 8-9 long in six layers and 306 to the box. Yes, of course, the figures are meaningless to the uninitiated; but the next time you pry the lid off a box of Hood River Delicious or Jonathans they may be packed in one of these ways, so it is desirable to know something about the system. Recourse to an accompanying drawing will make it clear.

The two packs illustrated were selected because they show the smallest of the 3-2 and the largest of the 3-3 packs. In the first-named there are eight apples in each lengthwise row, with alternating rows of 3 and 2 apples crosswise; the fruit is five layers deep; and there are 200 apples in a box. The 3-3 pack has alternate rows, longitudinally, of six and five apples; there are three in each transverse row; and the box contains 198 in six layers. Whatever the pack, and whether wrapped or unwrapped, the box is put on a gravity-type conveyor for delivery to the lidding press, and from there it goes, again by conveyor, to the cold-storage warehouse.

If a woman is doing the packing, she is in all probability working at a specially designed stand. It is of all-steel construction and mounted on casters so that it will move easily. The box is held in a slanting position while being filled, and all the packer has to do is to turn the stand and slide the package off on to the conveyor. In many states, labor laws prohibit women from lifting anything weighing as much as a box of fruit. Therefore, where equipment of this type is not in use, men must be employed to transfer the boxes.

The Hood River Apple Growers' Association markets approximately 75 per cent of the apples produced in that region, together with pears and other fruits. It has a membership of 450 active growers. The investment in buildings and equipment—represented by four packing plants and cold-storage warehouses, a vinegar plant, a cannery, and a spray-manufacturing plant—amounts to more than $1,000,000. If we were to add to that figure the value of the individually owned orchards and lands, the total would run into many millions. At the peak of the season, approximately 1,000 people are engaged in processing and packing the fruit for ultimate consumption.

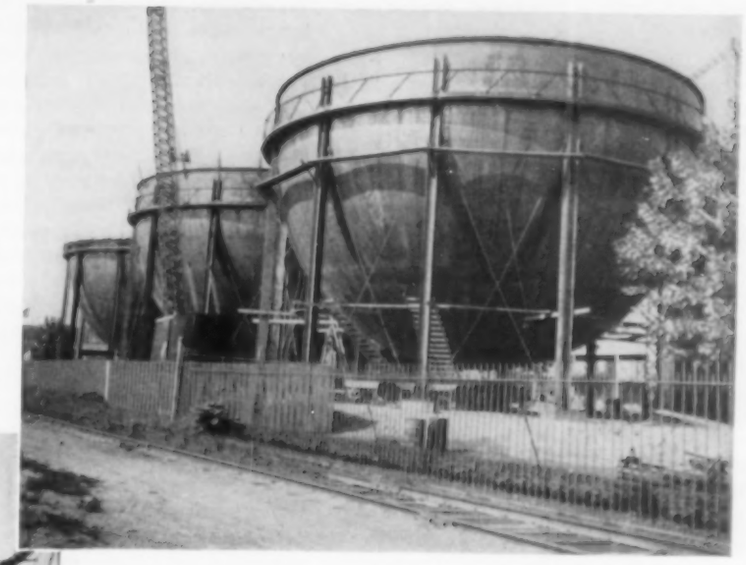
The magnitude of the operations of this organization, which is only one of many in the Northwest, can be gathered from the following facts. The 1940 crop yielded 1,700,000 boxes of apples, or 2,248 carloads—there being 756 boxes to a car—and 1,000,000 boxes or 1,390 carloads of pears. In addition, many cars of fresh cherries were shipped, while thousands of tons of apples, pears, strawberries, and cherries went to the cannery.

Last year's crop was a heavy one, and how to dispose of it profitably, in view of the loss of the foreign market and some Canadian competition, is a problem facing the industry. One thing is in its favor, and that is that 1940 was not a good apple year for the country as a whole. However, to absorb the surplus, all of us will soon have to start eating an "apple a day." This would probably solve the situation so far as the growers are concerned; but what would it do to the doctors?

WHERE GAS IS LIQUEFIED AND REGASIFIED

The picture at the right shows the three liquid-gas tanks in process of construction and are a part of the first commercial natural-gas liquefaction plant ever to be built. After a certain stage in the course of erection they were covered with canvas, as seen immediately below. Each holder has a capacity of 600,000 gallons and consists of a metal sphere within a sphere with a 3-foot space between packed with cork in both solid blocks cut to shape (lower right) and in powder form. To protect this insulation against moisture and possible expansion and rupture, dry gas is circulated through it. The cooling tower at the bottom provides the quantities of chilled water that are required in addition to ammonia and ethylene gas to reduce the natural gas to the low temperature at which it will liquefy

Photos from "The Lamp."



Liquefying Natural Gas for Storage

A. M. Hoffmann

IN the beginning of February, there was put in service in Cleveland, Ohio, a liquefying and storage plant for natural gas that will be watched with great interest by the industry. The indications are that it is an answer to the vexing problem of storing natural gas—of having available at all times a sufficient supply to meet sudden peak demands. One company has used a depleted gas field for the purpose, and some have compressed the reserve and stored it, when operations permitted, in the sands of oil fields. But these are exceptional cases, and most distributors have to maintain a pipe-line system equal to the greatest load that might be placed upon it even though that load is intermittent and of short duration. Holders such as are used for manufactured gas are not practicable for storing the large quantities of natural gas that are required to meet peak demands, especially during those seasons of the year when the hours of daylight are shortest.

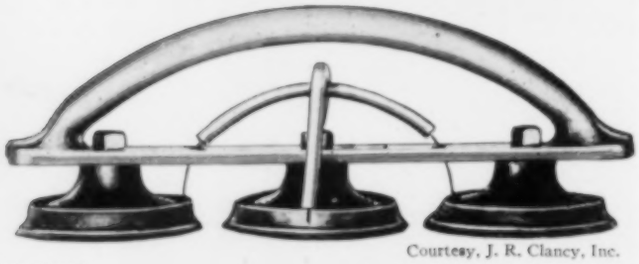
Today, various industrial gases are reduced to liquid form for shipment in tank cars. The advantage of this is obvious when it is realized that 600 cubic feet of natural gas will, when liquefied at a temperature of 250° below zero Fahrenheit, occupy only 1 cubic foot of space. Without any further preamble, the fact is that the East Ohio Gas Company, which serves Cleveland, Akron, Canton, Youngstown, and other important cities in northeastern Ohio, has built a plant that is equipped to liquefy 4,000,000 cubic feet of natural gas daily. The output is stored in three spe-

cial tanks with a combined capacity of 1,800,000 gallons, the equivalent of 150,000,000 cubic feet in gaseous form. Obviously, the product has to be regasified for industrial and domestic consumption; and the facilities provided for this purpose are said to be capable of effecting the change in the case of all three tanks in 50 hours, if necessary. The plant gets most of its supply from a field in West Virginia, 120 miles distant, by way of several paralleling pipe lines.

As desrcibed in a recent article in *The Lamp*, the process itself is an involved one. First ammonia is cooled under pressure. Next, the ammonia goes into a heat exchanger where it is brought in contact with ethylene gas which has previously been compressed and cooled by contact with water. At that stage the ammonia is allowed to expand by releasing the pressure, and as its temperature drops it absorbs heat from the ethylene and causes it to become a liquid. The cold, liquid ethylene passes, in turn, into a heat exchanger with natural gas, and the whole performance is repeated—the natural gas, which is under a pressure of approximately 600 pounds, is cooled to about –130°F. by contact with the ethylene and is liquefied. Finally, its temperature is allowed to drop to –250°F. by reducing the pressure from 600 pounds to atmospheric. This is done by means of special valves, and the result is liquefied natural gas at atmospheric pressure. At this last step in the operations a proportion of the liquid returns to the gaseous state; but, being extremely cold, it is put to work cooling the ammonia, ethylene, water, and the natural gas coming in from the field. It should be stated here that the present plant was preceded by a pilot plant at the Cornwell Station of the Hope Natural Gas Company.

Facilities for storing the liquid gas until it would be needed presented an engineering problem of considerable magnitude. It involved extensive experiments to determine the type of nickel alloy that would best withstand the effect of extremely low temperatures, since ordinary steel, when subjected to a temperature of –250°F., shatters under a slight blow and ruptures even under the stresses of expansion and contraction. The alloy developed is strong and ductile, and was used to build the inner of the two spherical shells that constitute a tank. The outer shell is of ordinary storage-tank metal and is 63 feet in diameter. The inner shell measures 57 feet. Between the two, and up to the point where the circumference is greatest and the weight rests, have been fitted cork blocks 3 feet thick. The remainder of the insulation consists of less-expensive powdered cork. As a precaution against the accumulation of moisture which might freeze and rupture the cork, dry gases are circulated between the two spheres.

During the winter months, when the demands on the gas industry are greatest —sometimes doubling and even trebling within a period of a few hours—the tanks are replenished as the liquefied gas is withdrawn. Regasification of the contents for delivery to the mains and service lines is effected by raising the temperature of the liquid from –250 to +60°F. There is a little evaporation during storage, and this gas is drawn from the tanks and fed into the distribution system. In time of lesser demand the plant may be shut down. In this way it is not necessary to provide pipe lines large enough to meet peak loads, and consumers will be assured an ample supply regardless of the season of the year.



Courtesy, J. R. Clancy, Inc.

SURE GRIP AND LIFT

Of the numerous services now performed by vacuum cups, perhaps the most important is that of handling sheet glass, metals of all kinds, and other smooth and sometimes oily, sharp-edged materials. They range all the way from small units, some with long handles suitable for picking up and feeding blanks into presses, to large ones with single, double, and triple cups capable of lifting approximately 60, 120, and 180 pounds, respectively, with safety and dispatch. A model of the latter kind is seen at the bottom, right. It is known as the Sure Grip Eveready Lifter. Above it is pictured a worker using two 2-cup units of the same type to equalize the load in shifting flat and heavy pieces of steel. Where a sheet is too large or too heavy for one man, it can be handled readily by two, each equipped with a lifter of adequate capacity. Suction is quickly applied or broken by the movement of a finger. Another interesting application is illustrated at the left. It shows a small, light-weight ladder which is provided with vacuum cups at the top and friction tips at the bottom to prevent slipping and damage. It is aptly named Kar-Ladder because it was primarily designed for the use of long-distance buses, garages, and service stations.

Carlton-Tunnel Drilling

THE Carlton Tunnel furnishes a striking example of what can be accomplished with detachable bits because conditions there have been favorable to setting up a standardized system of using and reconditioning bits. Consequently, as an article in this issue points out, their performance in that notable mine-drainage gallery, that is being excavated under an extensive mineralized area in the Cripple Creek District of Colorado, has probably not been surpassed elsewhere.

The tunnel has been driven more than 5 miles through granite of great uniformity. It has been possible to drill a certain distance with each succeeding size of bit, and to do it consistently. The rock is not highly abrasive, and the reduction in bit gauge has been comparatively small. The wear on bits, on both cutting edges and reaming faces, has been more or less constant day in and day out. Moreover, drill rounds have not varied in depth. Nine-foot holes have been used all the time, and they have been put in with three bit changes, each bit in the sequence of four doing the same relative share of the total work in each round. The air pressure at the drills has been relatively high and has not varied.

Under these circumstances, the management has been able to systematize the handling and reconditioning of bits to a degree that is seldom possible, and consequently has reduced the cost per bit used to a figure that any mine operator might well envy. That such a record could be made on a tunneling job is significant. When detachable bits were introduced, a good many hard-rock men were of the opinion that they did not have any outstanding advantages over conventional steel for tunneling. What was generally recognized to be their strongest point was that they reduced transportation costs to a minimum: an item of great importance in mining but not in tunneling where muck cars continually shuttle back and forth between the heading and the portal. Nevertheless, the adoption of detachable bits at the Carlton Tunnel served to speed up operations appreciably, and the results obtained there have already influenced some other tunnel drivers to use them.

The drilling speed at the Carlton Tunnel is attributable in no small measure to small drill holes. The reduction in starter bits from 2⅛ to 1¾ inches has cut the over-all time of drilling a round by 32 per cent. It has increased the actual drilling speed more than that because the rate of rock penetration varies roughly in inverse ratio to the square of the diameter of the drill hole. Nine-foot holes are finished with bits which are, in some instances, only 3/16 inch smaller in diameter than the bits with which they are started, and in no case is the difference greater than 5/16 inch. This can be done because Jackbits can be milled within very close limits. In resharpening conventional forged steel, on the other hand, this is not possible. Consequently, when the latter is used, the variation between starting and finishing sizes of bits is necessarily greater. It therefore follows that a hole, to bottom it at a given diameter, must be started with a larger bit in the case of conventional steel than when detachable bits are employed. Obviously, then, the same drilling speed cannot be obtained.

In few if any mines are the drilling conditions as favorable as they are in the Carlton Tunnel. However, with detachable bits there are greater opportunities for effecting savings in mines than in tunnels. The point to be brought out here is that Jackbits have scored a noteworthy success in a class of work that was not thought to be especially favorable to them. In view of this fact, it is not unlikely that their performances in mining will be even more effective than they have been, once the mining fraternity becomes fully cognizant of their possibilities and develops the technique of handling and reconditioning them on a truly scientific basis.

Labor's Leisure

WHEN men in factories worked long hours day in and day out, did much actual physical labor with their hands, and likely as not walked to and from their places of employment, there was little reason to be concerned about what they did in their spare time. They didn't have a great deal of leisure, and they were tired enough to want to rest when they got home. Shorter hours, labor-lightening mechanical aids, and automobile transportation have changed the situation in recent years and created a need for industrial recreation programs. Managements have, on the whole, been quick to provide suitable facilities, and are now sponsoring diversified employee recreation. There is general agreement that such activities are worth far more than their cost, both to employers and employees.

Corroboration of this viewpoint is found in a monograph prepared by two Purdue University researchers, F.R. Eastwood, associate professor of physical education, and L.J. Diehl, a fellow of the research foundation. Their studies disclosed that there is now a distinct tendency in industry to guard against fatigue and destruction of workers' health, and to protect and conserve the human element in production. Recreational facilities for plant workers range all the way from stamp collecting and photography to baseball and clambakes. They include well-defined programs for women as well as for men. Among the men, physical sports are the greatest attraction, the leading ones being, in order, bowling, softball, basketball, golf, and baseball.

In summarizing the values inherent in industrial recreation, Messrs. Eastwood and Diehl state: "We must recognize that if a man has an extra hour or two to rest thrust upon him, and doesn't know what to do with it, he may drink, gamble, go to cheap shows, overeat, quarrel with his wife, or squander his time and money in other profitless ways."

Improved Method of Cistern Cleaning

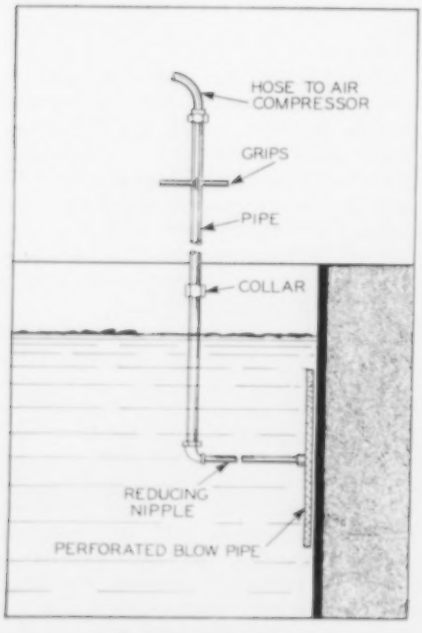
CISTERNS and reservoirs, which are generally kept filled by roof drainage, are ceaseless collectors of coal soot and dust. Much of this material passes through the ordinary filtering system into the storage water, where it undergoes a chemical change and forms a dark, resilient residue that settles and clings to the sides and bottom. Cleaning by pumping out the water does not remove coal residue, and swabbing with chemicals is invariably necessary for a complete job. This is tedious and often expensive work. Recently, compressed air has been tried for the purpose and found to be of considerable aid in saving both labor and operating costs.

The equipment required for the air-cleaning method, as generally practiced by contractors and vault men, is a 10-foot section of iron pipe, 1 inch in diameter, with a collar in the center for extension where cisterns or shafts are deep. To the bottom of the pipe is fitted an elbow into which is screwed a reducing nipple 12 inches long and ½ inch in diameter. Attached to the latter by a Tee connection is a blowpipe that is of the same length and diameter, is plugged at both ends, and has numerous small perforations in the outer side. The 10-foot section is provided with grips, and the top is threaded to take a hose that leads to a compressor. The device is known as a residue cleaner, and can be operated in conjunction with any suitable pumping equipment.

Many modern contractors use either standard or 2-stage type sump pumps for lifting water from cisterns. They are operated by gasoline-engine-driven compressors mounted on a service truck, or by a small portable capable of delivering air at 100 pounds pressure per square inch. With such an outfit, and with the air lines of the cleaner and the pump interconnected, it is possible for both to work at the same time. Where cisterns are unwatered by other means, a small air-cooled compressor, also gasoline-engine driven but supplying 5 to 10 cubic feet of free air per minute, serves the residue cleaner.

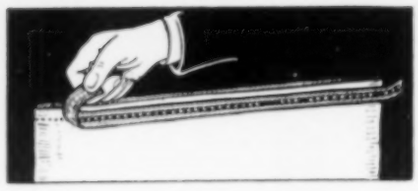
Operations are begun by starting the pump. As soon as the water begins to flow, the cleaning device is lowered into the cistern until the perforated pipe is 4 or 6 inches below the water level. Then air at from 10 to 12 pounds pressure is admitted. Holding it firmly by the grips so that the blowpipe is close to the wall, the worker gives the unit a circular motion as he covers every foot of the surface as pumping continues. The force of the air and the resulting agitation of the water combine to loosen the film; and by the time the bottom of the cistern is reached, from 60 to 80 per cent of the material has been removed from the walls, mixed with the water, and been pumped out. The floor is treated in a similar manner; but as the deposit there is thicker than elsewhere, progress is slower and more air pressure is required to clean it.

The diversion of compressed air into the blowpipe seldom interferes with the pumping operations, and any extra attention that this set-up may need is offset by the well-nigh complete elimination of follow-up work. Swabbing does not often have to be done—lightly spraying the surfaces with a common soda solution is all that is usually necessary to assure a thoroughly satisfactory job.



RESIDUE CLEANER

This blowpipe works while the cistern is being emptied. The cleaning is done with compressed air, and as the material is loosened it is pumped out with the water.



Cement-Bag Rip Closure

MARKING and closing cloth cement bags so they can be opened easily are done in one operation by a special high-speed sewing machine, according to an announcement of the Bag Closure Corporation. The unit includes a feeder table, an automatic cutter, conveyor and discharge tables, and a mechanical stacker. By means of this equipment the bags can be closed in one of three ways: First, by stitching them shut with a cord having a minimum tensile strength of 70 pounds; second, by sewing down with the cord a paper strip on which the contents, name of cement plant, etc., are plainly printed; and, third, by attaching two strips, one on each side. The cord and paper overlap 2 inches on each side, thus permitting a bag to be opened from one or the other simply by taking hold and ripping the fastening. This breaks the needle thread progressively without damaging the bag fabric. One advantage of the double strip is that when the under one is removed the broken bits of cord come off with it, leaving the bag ready for cleaning and reuse if it is in good condition. It is said that an operator with average skill can apply the rip-cord closure at the rate of 900 and more an hour. The stacker can be set for 50 or 100 bags, a counter and bell signal giving notice when the determined number has passed the cutter. Sufficient cord is carried for a 2-hour run, and new rolls of paper are added on the fly.

Cement Industry Possible User of Carbon Black

ACCORDING to the findings of laboratory work at the Mellon Institute, the use of carbon black in the manufacture of cement has definite advantages. The colloidal carbon assists in the grinding operations; and the research was made possible through the Industrial Fellowship of the Columbian Carbon Company. A report of the investigations reveals that by adding as little as 0.32 per cent of carbon black to the clinker, the fineness of the cement was increased by 30 per cent when the grinding time remained constant, or, when the product was ground to a constant fineness, the grinding time was decreased by 28 per cent. When the dosage was stepped up to 1 per cent, the improvements mounted to 50 and 34 per cent, respectively. As compared with controls, that is, cement ground under similar conditions but without the application of carbon black, mortars made with the new product showed greater strength properties in tensile and compression tests. The improvements are attributed principally to the increase in fineness of the cement, although there is every indication that the carbon black itself helps to bring them about.

The colloidal carbon used was in the form of tiny pellets called Cem Beads. When added in the proportion of 1 per cent, the material did not, with the exception of color, appreciably alter the consistency, setting time, and soundness of the cement and had no noticeable effect on its resistance to alternate freezing and thawing. It is the belief of the laboratory men that the experiments have established the effectiveness of colloidal carbon as a grinding aid in the production of portland cement. Copies of a publication describing the investigations may be obtained from the Mellon Institute, Pittsburgh, Pa.

Harnessing Wind Power for Distribution

WIND power has done useful work since time immemorial, and in Europe today wind mills are still familiar and picturesque objects. But harnessing the forces of the wind on a scale that will permit distribution over transmission lines to scattered points of consumption is something different. No less an authority than Arthur D. Little, Inc., is responsible for the statement that wind power will soon feed Vermont power lines. This is based on months of aerodynamic and meteorological studies, which have resulted in the Smith-Putnam wind turbine equipped with vanes that have the appearance of airplane wings with a spread close to that of the largest modern bombing plane.

The first sizable plant is located in the Green Mountains near Rutland and on top of Grandpa's Knob where the wind is said to be sufficiently steady to provide an availability factor greater than that for stored water as used in New England. This is but one of a number of sites in the region suitable for the purpose. The vento-electric station, as it is called, has been designed to develop 1,000 kw.; and the plan is to connect a series of these stations with one or more reservoir-fed hydroelectric plants so as to assure a greater block of firm power than can now be supplied.

One of the principal problems confronting the engineers was that of providing a speed regulator for the generator that could be depended upon to prevent serious overloading such as would occur when uncontrollable gusts, or great fluctuations in wind velocity, raise the output from 1,000 to 3,000 kw. in less than three seconds. This and other problems, including that of ice formation, have been effectually dealt with, according to the *Industrial Bulletin* of Arthur D. Little, Inc., placing this new type of electric station on a practical basis.

Earth-Bound Test Flights

Without leaving the ground, engineers of the Boeing Aircraft Company are making test "flights" under conditions such as would be encountered in the substratosphere and stratosphere at altitudes up to 40,000 feet and more. This concern has recently completed the first fleet of substratosphere transport planes; and the work with the strato-chamber is being done primarily in the interest of crew comfort and operating efficiency at extremely high altitudes.

The chamber is built of steel and consists of air locks, vacuum pumps, superchargers, refrigerating equipment, and a multiplicity of control valves, instruments, etc. It has two compartments: one with normal, warmed air like that in a supercharged airplane cabin, and the other containing rarefied, frigid air such as is found in the stratosphere. So confined, and breathing oxygen supplied by gas masks in the latter case, the laboratory men can reach any desired altitude in a few minutes and determine the conditions under which actual flights at that height can be made with the most comfort to the occupants of the flying machines.

Plating Under a Vacuum

ALNICO magnets—those tiny but powerful bodies that can lift their weight hundreds of times over—have greatly simplified the work of plating small aluminum disks with vaporized selenium. The apparatus of which they constitute a vital part has been developed in the General Electric Research Laboratory; and the disks are used in the making of photoelectric cells. The metal has to be deposited under a vacuum because selenium oxidizes when exposed to the air; and the higher the vacuum, the lower the temperature at which it vaporizes. Furthermore, each disk has to be handled and treated separately; and how to do this inside of a closed, evacuated chamber presented something of a problem.

As has already been intimated, the mechanisms that feed and move the disks in the new device are controlled by alnico magnets, which are "geared" for the purpose. One of these is fitted around the lower end of a brass tube that connects with and is sealed to the base of the glass-encased vacuum jar. This magnet revolves, and as it does so another one inside the tube revolves in unison. This set raises the disks to the transporting arm through the medium of a screw which carries a nut, a single turn of the screw lifting the nut a distance equal to the thickness of one disk. A second set operates the transporting member by means of a cam and gear mechanism.

The apparatus is designed to take 100 disks, and each is fed in turn to the arm that moves it to the small selenium oven or vapor chamber. There it is held for a prescribed period before it is added to the stack of plated disks. By this arrangement it is possible to do the work without a connecting shaft, which would have to be introduced into the vacuum jar if the usual form of drive were used.

MAGNETS DO THE WORK

The vacuum jar in which small aluminum disks are coated with selenium, and Dr. C.W. Hewlett who built it. 1—Alnico magnets; 2—brass tube; 3—vacuum line; 4—selenium oven; 5—transporting arm; 6—uncoated disks; and 7—plated disks.

Industrial Notes

How about Sun Dodgers as a name for a social society made up of tunnel, subway, sewer, and subaqueous-construction workers, contractors, and engineers? With The Moles in existence in New York City since 1936, and the newly organized Ground Hogs in Chicago, there may be a dearth of suitable names if men engaged in this class of work in other large cities decide to follow suit.

For arsenals and other establishments where the danger of explosions must be guarded against, the H.H. Porter Company has developed a fireless steam locomotive. It is designed on the principle of the thermos bottle, and runs on steam taken from a plant's boilers. It can take on enough steam in ten minutes to keep it going for two hours.

Quartz is hard on stamp mills; but less so, states The B. F. Goodrich Company, if they are lined with Armorite rubber instead of manganese steel. Actual service tests were made with both, with the following results, as reported by a large western concern: After more than 3,000 tons of highly silicified gold-bearing quartz had been crushed in a mill, the ¾-inch rubber lining showed practically no wear and very little "roughing up," while a similar tonnage wore down the 1-inch metal lining from about 33 to 50 per cent.

LIFTS WITHOUT SLINGS

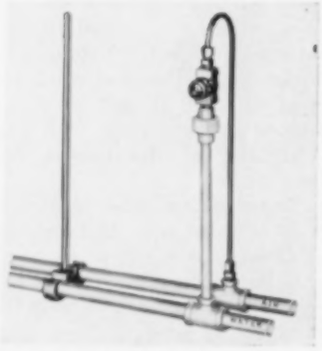
This improved type of Never-Slip Safety Clamp is made to lift metal plates, sheets, structural shapes, etc., in either the vertical or the horizontal position. The device has a replaceable, grooved jaw liner of hardened steel that gives it greater hold and lengthens its service life. It is available in ten styles for handling material from ⅛ inch to 6 inches thick and weighing up to 12 tons.

For safer night driving, the Ohio Department of Highways has marked 265 miles of its main roads with what it calls reflectorized paint. The paint itself is of the kind ordinarily used for highway center lines; but into it have been poured tiny glass beads that do not show in the daytime but become luminous at night, making the stripes stand out plainly in the beams from automobile headlights. They have been found especially helpful in guiding traffic in areas where fogs are prevalent. Tests conducted by the Division of Traffic and Safety indicate that the reflectorized paint also has greater wearing quality than standard pavement-marking paints.

Recording charts that can be wiped clean with a damp cloth for continuous service are a product of the Permochart Company. They are made of vinylite plastic, which is noninflammable and resistant to oil, gasoline, and grease, and have reinforced centers. Each is guaranteed for daily use over a period of two years under normal working conditions; and for industrial establishments that require many recording instruments and save the records, the company has established a microfilm photographic system for reproducing and filing the latter. Permocharts are available for all typs of circular recorders: special forms are made to order.

Comparative tests conducted recently with tempered-glass lenses and lenses made of Tulca, a nonshatterable material, would seem to indicate that the latter offer greater eye protection. Both types were identical as to size and curve, and 40 of each were used. The blows were applied with ⅝-inch hardened-steel balls, weighing 1, 2, and 3 ounces, dropped from varying heights on to each lens resting in a rubber-cushioned anvil. It is reported that all the Tulca lenses showed resistance to breakage up to and including the sixth impact, which was made with a 3-ounce weight falling a distance of 54 inches, and that some of the glass lenses were shattered at the third impact with a 3-ounce ball that was dropped from a height of 39 inches.

What appears to be a simple humidifying set-up for industrial applications has been designed by Spraying Systems Company and is shown in the accompanying illustration. The main feature is a special nozzle by which water, oil, or any other liquid of similar viscosity is completely atomized with compressed air and sprayed varying distances up to 20 feet, depending upon the pressure. Air at from 5 to 60 pounds is used, 30 pounds being required for ordinary purposes. A group of these nozzles is mounted close to the ceiling and above the air and water lines. The compressed air is regulated by a solenoid-operated valve actuated by a humidistat, and the level of the liquid is maintained slightly below the nozzles by means of a float-controlled tank. There are two types of nozzles having an atomizing range of 0.1 to 3.9 gallons per hour at an air consumption of 0.3 to 2.9 cfm. It is claimed that the system cannot drip. If the air supply is shut off for any reason the water will drop back to the predetermined level.



Last year, the California Division of Highways did some experimenting with steel bridges in order to prolong the life of the protective paint. Four structures of this type requiring repainting were gone over with oxyacetylene torches after sandblasting to rid the metal of every trace of moisture. For this work the flame was kept as nearly neutral as possible, the recommended proportions of the gases being 1 cubic foot of acetylene and 1.04 cubic feet of oxygen. In the case of bridges along the coast, the steel was thoroughly washed with fresh water after sandblasting and before dehydrating, as the engineers term it. The method can also be used to flame-clean rusty steel.

Prospecting for oil may in future be done by a direct method based on the fact that gas from subterranean reservoirs leaks up through the earth and escapes at the surface in minute quantities. Measurement of this gas at various points in a given area will, it is believed, give data that will make it possible accurately to plot reservoirs of oil thousands of feet below the surface and even forecast the kind of field it is—gas, oil, or condensate. The method was given its first test in the vicinity of the Moosic Mountain oil field in Pennsylvania; and it is claimed that the results obtained not only corresponded closely to the known facts about the district but also disclosed what promise to be productive sands in a nearby area which has not yet been drilled. This would seem to be going back to first principles, as the early oil wells were discovered through so-called oil springs or surface leaks.

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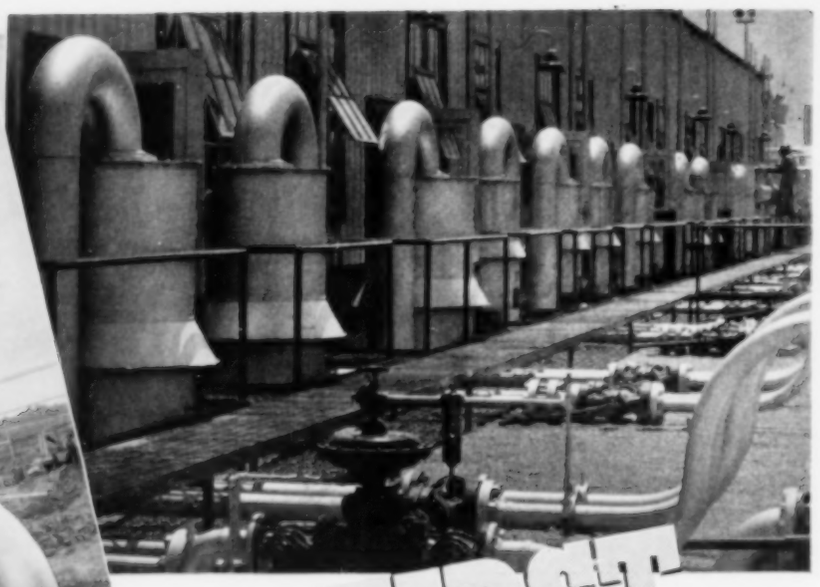

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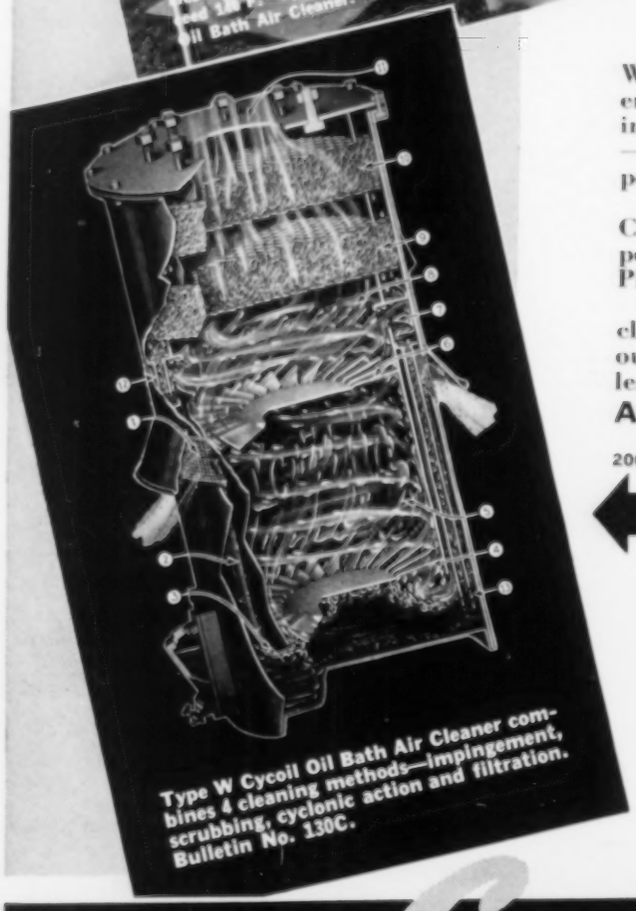

Type W Cycoil Oil Bath Air Cleaner combines 4 cleaning methods—impingement, scrubbing, cyclonic action and filtration. Bulletin No. 130C.

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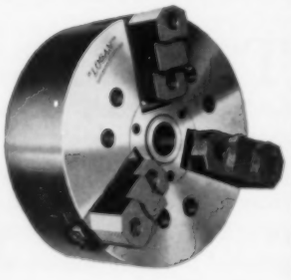

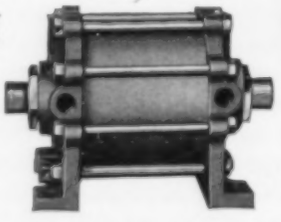

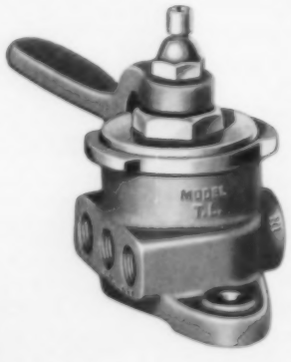

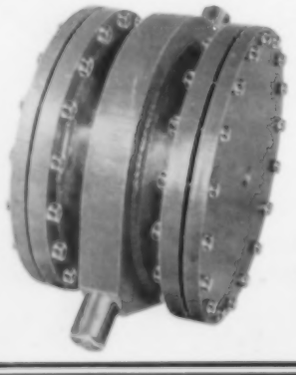

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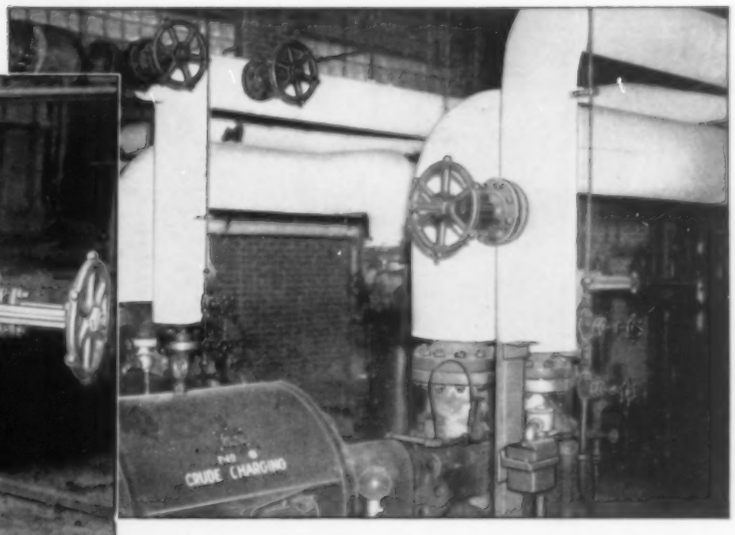

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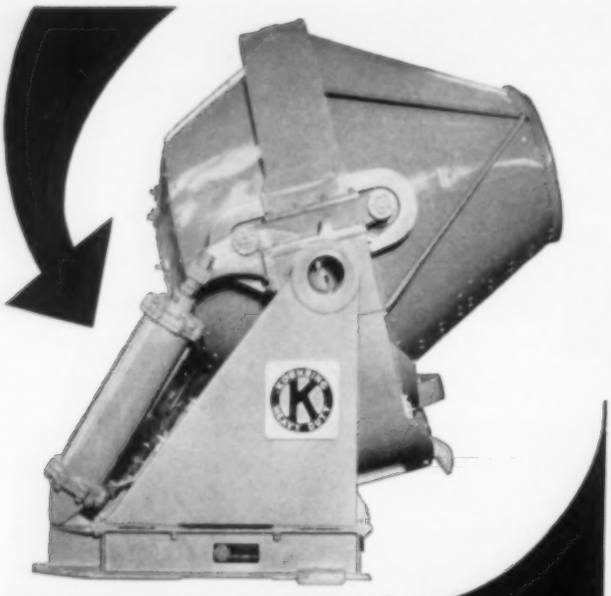
The standard temperature rating for 150 Pound valves is 500° F.; Vogt rates its construction at 750° F.; but the Vogt drop forged carbon steel valves shown above are OPERATING REGULARLY AT 850° F. in one of the world's largest refineries.

These valves feature (1) all flanges forged integral with extra thickness to newest A. P. I. specifications, (2) round, bolted, one-piece bonnet, (3) oversize stuffing box, (4) removable yoke nut, (5) solid wedge gate, (6) heat treated stainless steel trim, (7) high temperature studs and nuts, (8) materials up to Vogt "high pressure" standards.

For doing a tough job . . . it's VOGT for Valves!

HENRY VOGT MACHINE CO., INC., LOUISVILLE, KY.

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • CINCINNATI • ST. LOUIS • DALLAS



NOPAK Air Cylinders Help Set World's Record

A new world's record for pouring concrete was established on the giant Coulee Dam project. A vital factor in this performance was the battery of eight 4-cubic yard Koehring Concrete Mixers. Revolving and tilting continuously for 24 hours, without stop, they produced an average of 861 cubic yards of concrete per hour.

NOPAK Air Cylinders, both Standard and Heavy Duty, are available in Non-Cushioned, Self-Regulating Cushion and Adjustable Cushion Types—in 6 standard mountings.

A pair of NOPAK Heavy Duty Air Cylinders on each mixer (controlled by NOPAK 3 and 4 way operating valves) tilted and dumped the heavy mixer drums, loaded to capacity, from 24 to 27 times an hour. Could you ask for a more severe test of cylinder durability and power, plus smooth unfailing performance?

The flat-disc principle, basic patented feature of all NOPAK operating Valves, makes them practically leakproof and wearproof, provides perfect control of air cylinder movements.

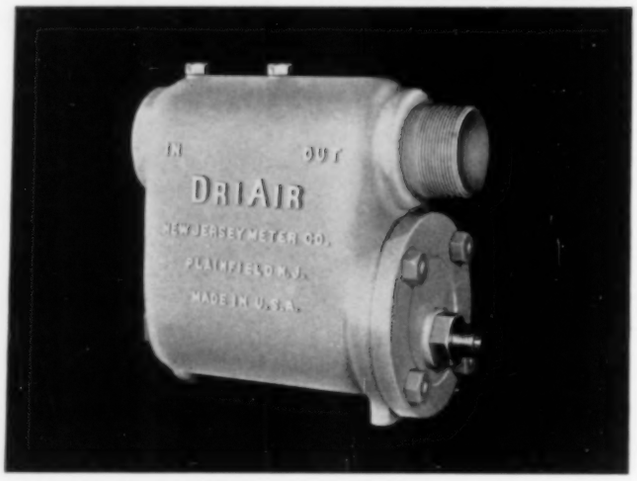
Isn't this the kind of valve and cylinder performance you want to step up operating efficiency of your plant right now when high speed, uninterrupted production is so vital? Then write today for illustrated literature and engineering data on NOPAK Valves and Cylinders for Air and Hydraulic Service.

GALLAND-HENNING MFG. CO.
2752 S. 31st Street MILWAUKEE, WIS.

Representatives in Principal Cities

NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

LET *Experience* BE YOUR GUIDE

TO THE SOLUTION OF YOUR PISTON RING PROBLEMS

International Operator Reduces Cylinder Maintenance Cost 66%

EQUIPMENT

3—800 H.P. 4-cycle Diesel Engines located in South America.

PROBLEM

High rate of cylinder wear and waste of fuel from "blow-by".

CORRECTIVE ACTION

Replaced the original open joint style rings used with COOK'S time tested ring combination of Graphitic Iron Plain Rings and COOKTITE Sealing Rings as shown in the accompanying illustration.

RESULTS

Checking the records compiled during the 8 years since the original COOK'S Rings were installed shows:

(1) Rate of Cylinder wear reduced an average of 66%.

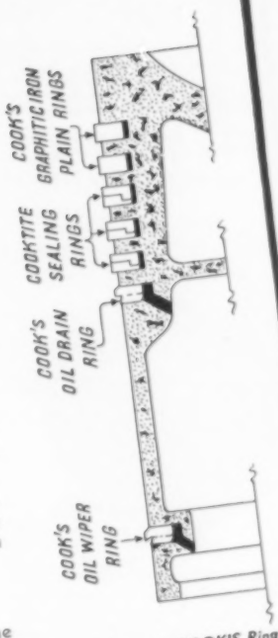
(2) A fuel saving of .06 lb. per Brake H.P. hour. Engines operate more efficiently than maker's guarantee.

(3) Results were so satisfactory, use of COOK'S Rings has spread to many additional Diesel as well as other plants operated by this company in North and South America.

SOURCE OF DATA

Taken from reports filed by Chief Engineer of plant with the Company's Supervising Engineer in the home office.

*Case History 80-SA



This is the COOK'S Rings combination that was used

THIS CASE HISTORY *and the others in this series are typical of the many in our file, supplied by operators of prime movers throughout the country who have found the answer to their ring problems in a change to COOK'S GRAPHITIC IRON PISTON RINGS.*

COOK'S GRAPHITIC IRON Piston Rings

"Sealing Since 1888" Pressures

COOK'S GRAPHITIC IRON PISTON RINGS

lower the rate of cylinder wear, increase h.p. output per gallon of fuel and restore new engine power, even after cylinders are badly worn. These results are assured by the combination of (1) COOK'S GRAPHITIC IRON — the highly refined COOK'S Ring material; (2) exclusive designs that positively and permanently seal combustion pressures; (3) pre-conditioned wearing surfaces. You too can reduce your operating and maintenance costs by installing COOK'S Rings next time you make replacements. Ask for informative literature.

C. LEE COOK MANUFACTURING CO.

INCORPORATED

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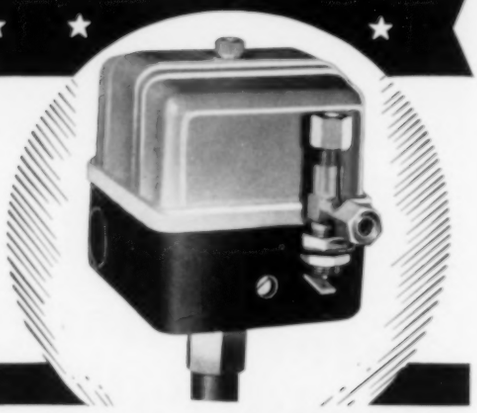
Experience says **"IT PAYS TO USE COOK'S GRAPHITIC IRON PISTON RINGS"**

AN ACCEPTED STANDARD ★ ★ ★



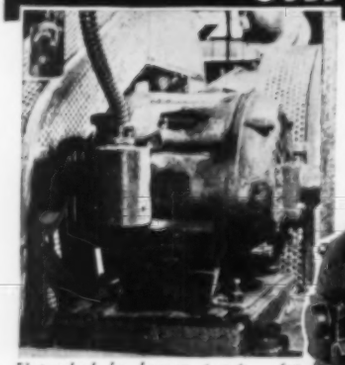
CLASS 9210 TYPE A3 PRESSURE SWITCH

For the garage type air compressor, ratings up to 1½ H. P. 110 V, 2 H. P. 220 V single phase and 3 H. P. 220 V polyphase, use the 9210-A3. The pressure limit is 200 lbs., adjustable range and differential. Direct connection to release valve without fittings. Priced right.

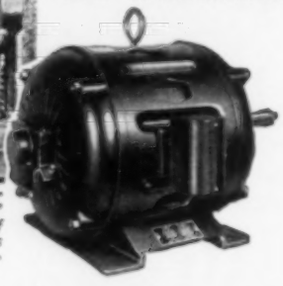
SWITCH—PROTECT—REGULATE . . . DO IT ALL WITH SQUARE D

SQUARE D COMPANY • REGULATOR DIVISION • DETROIT

Shut-Downs Caused by Motor Failure *Cost You Money!*



use **DEPENDABLE WAGNER MOTORS on your PUMPS and COMPRESSORS**



Untouched by human hands . . . for months on end, and still giving "top" performance. That is the record of thousands of Wagner motors such as the 20-hp type RP driving the air compressor in the above photo.

Safeguard your plant against excessive motor maintenance and lost production time by selecting motors that have a reputation for dependability and efficiency. Because Wagner motors are varied mechanically to meet all operating conditions, and varied electrically to meet the requirements of different types of equipment, they are ideal for use in operating all types of pumps and compressors. . . . Whether buying new equipment or replacing motors on equipment you have, it will pay you to specify Wagner. . . . Get the facts—write for bulletins MU-177 and MU-182.

M41-12

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SOUNDLY DESIGNED • STURDILY CONSTRUCTED

ERIE GOVERNORS— For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

ERIE UNLOADER — Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

JARECKI VALVES— Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

JARECKI FITTINGS— Air-furnace malleable fittings...close-grained, cast iron fittings, all with perfect threads. A complete line.

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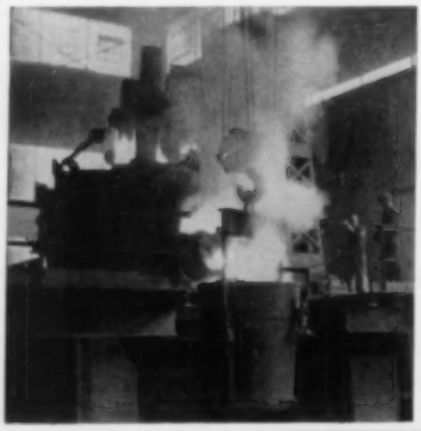

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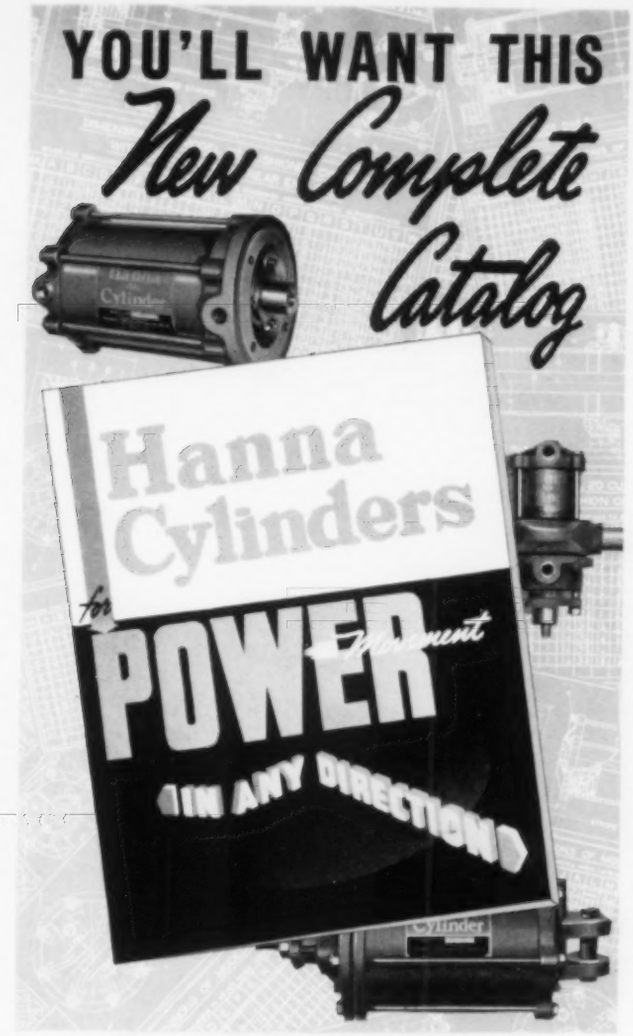
COMPLETE control of all processing from selection of the melting charge to the finished condition is the N. F. & O. *guarantee of quality* in forgings furnished to your specifications–Smooth Forged, Hollow Bored, Rough or Finished Machined.

NATIONAL FORGE & ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA. U. S. A.

YOU'LL WANT THIS *New Complete Catalog*



TO CHOOSE THE *RIGHT* CYLINDER *QUICKLY*

HERE it is — the new Hanna Cylinder Catalog No. 230—just off the press — packed full of illustrations, dimensions, capacities and valuable engineering data to help you select the proper cylinder for every application. In addition to covering the broad line of standard Hanna Cylinders, this new catalog covers cushioned cylinders, operating valves, speed control valves, and accessories.

Catalog 230 is available to executives and engineers requesting it on company letterheads. No obligation, of course. Write today.

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1765 ELSTON AVENUE • CHICAGO, ILLINOIS
Air & Hydraulic RIVETERS • CYLINDERS • Air HOISTS

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"After three months service Lattice-Braid on a plunger type mine pump handling water containing excessive sediment is still performing perfectly."
"On a centrifugal pump handling silicate of soda at 3000 F. Lattice-Braid has lasted four times as long as any other packing heretofore tried and is still giving 100% service."
"Lattice-Braid is the best packing we have ever seen for sand pump service."

PATENTED

GARLOCK LATTICE-BRAID Packing is available in the following styles: GARLOCK 730 for centrifugal and rotary pumps handling hot or cold water, caustic solutions or weak acids. GARLOCK 731 for rods operating against steam, gas, acids, lye and caustic soda solutions. GARLOCK 732 for heavy duty service against high pressure steam or hot oil. GARLOCK 736 for centrifugal or rotary pumps handling acids or strong chemical solutions. GARLOCK 751 for centrifugal or rotary pumps handling cold oil or water.

MANY TYPES OF SERVICE Since it was introduced several months ago the new Garlock LATTICE-BRAID Packing has proved itself by superior performance on many types of service.

LONGER LIFE The unique structural design of LATTICE-BRAID holds strands together (even when the material is worn far beyond the serviceable limits of wear of ordinary braided packings), provides unusual flexibility and imparts semi-automatic pressure action.

Write for illustrated folder!

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PALMYRA, NEW YORK
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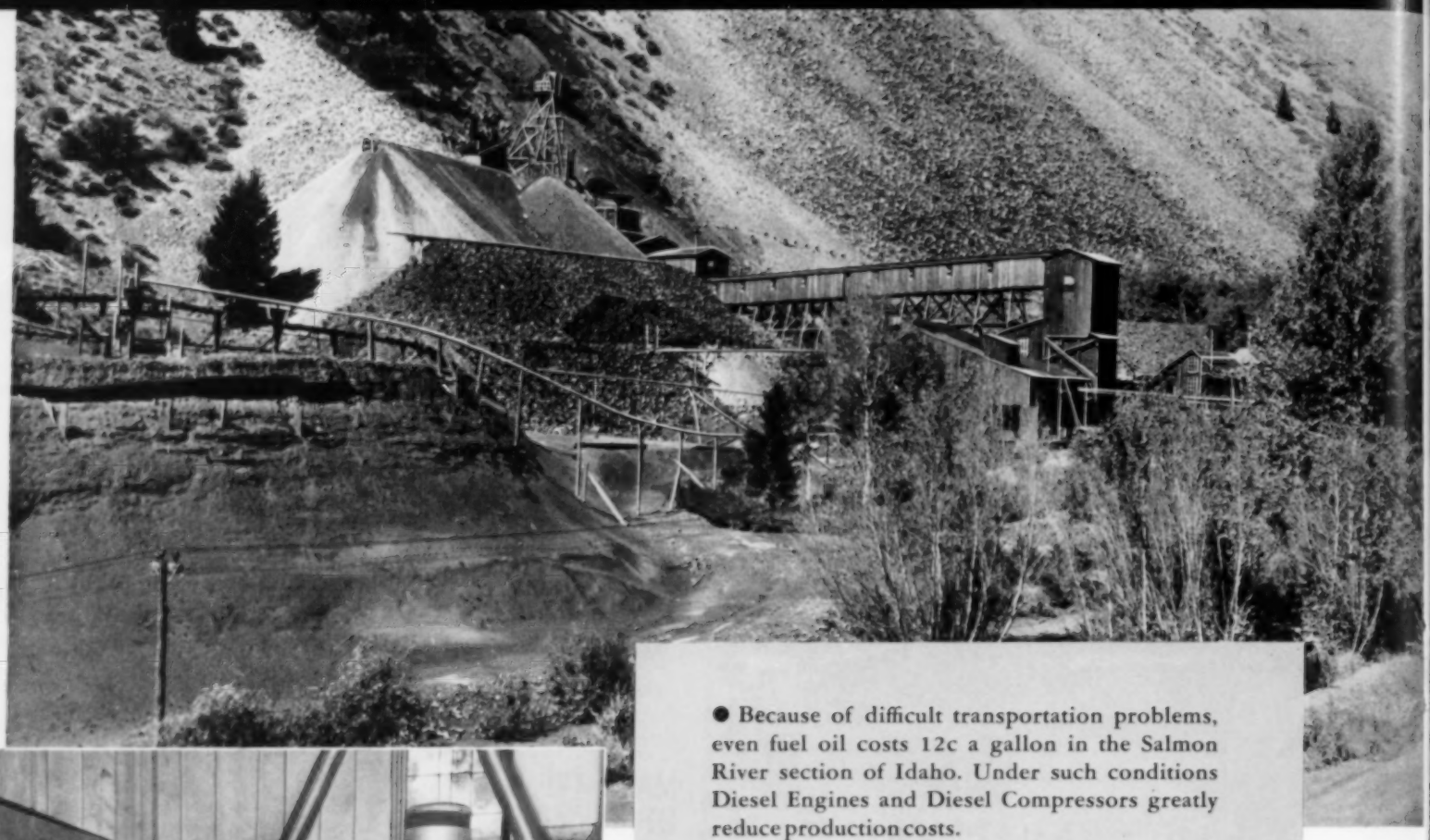
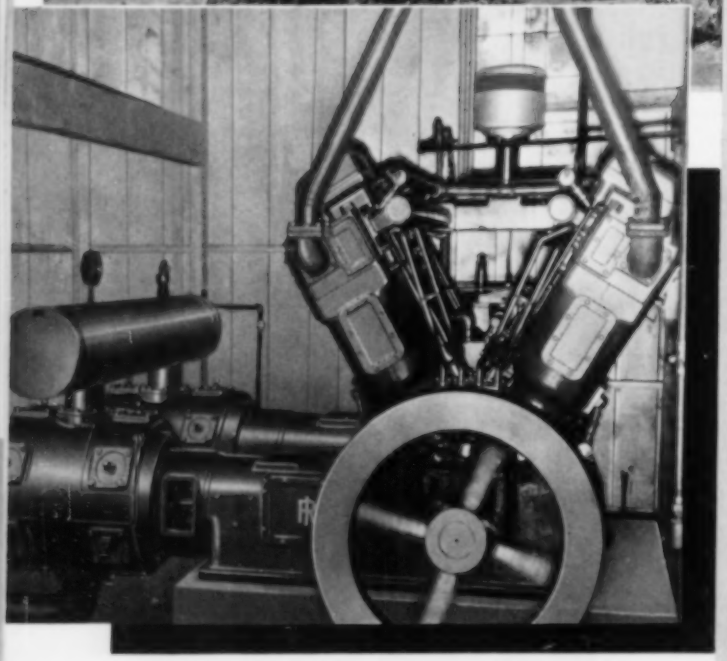
Garlock **LATTICE-BRAID**

TYPE XVO DIESEL-ENGINE-DRIVEN COMPRESSOR *at Clayton Silver Mines in Idaho*





The 4-XVO two-stage Diesel-engine-driven Compressor at Clayton Silver Mines. Starting air is supplied by an Ingersoll-Rand 3-hp Type 30 starting air compressor.

Other Ingersoll-Rand products include air and gas compressors of every type and size, rock drills, centrifugal pumps, condensers, oil and gas engines, and pneumatic tools.

● Because of difficult transportation problems, even fuel oil costs 12c a gallon in the Salmon River section of Idaho. Under such conditions Diesel Engines and Diesel Compressors greatly reduce production costs.

The Clayton Silver Mines studied their problem carefully and selected an Ingersoll-Rand XVO Diesel-engine-driven Compressor for their air supply. This unit, at 6000 ft. elevation, compresses 6600 cu.ft. of free air to 100 lbs. pressure for each gallon of fuel consumed.

The design features of the Type XVO insure efficiency, reliable operation, and long service life. Four-cycle engines are today unchallenged in the field of moderate-speed, heavy-duty power equipment of this kind. Channel Valve Compressor cylinders are the acknowledged standard of comparison.

This thoroughly modern unit is the result of many years experience, and combines the outstanding features of Ingersoll-Rand Diesel Engines and Ingersoll-Rand Compressors.

Before selecting your Compressor be sure and get full particulars on the Type XVO—also on Type S Diesel Engines for all power purposes.

Ingersoll-Rand

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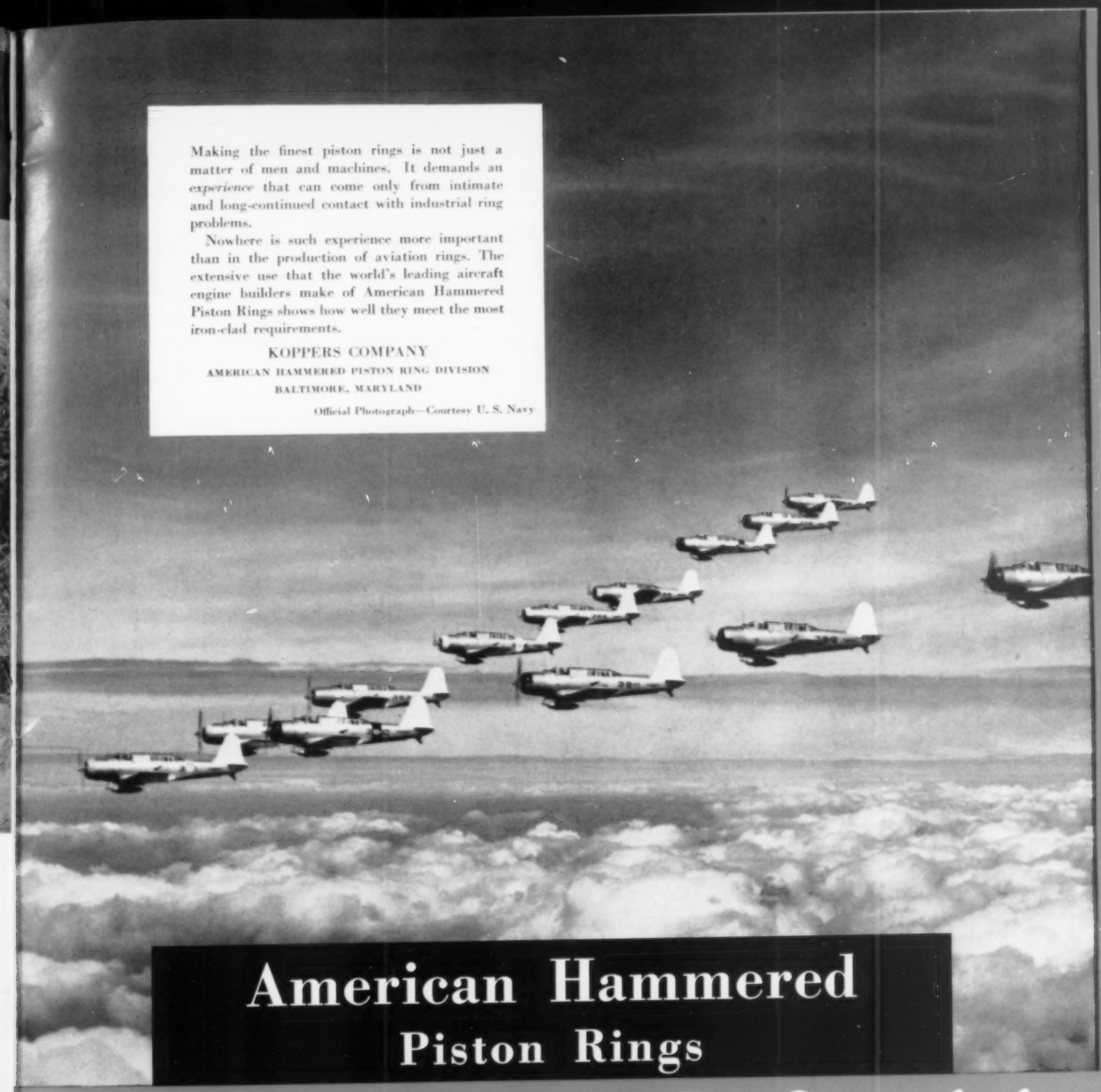

Making the finest piston rings is not just a matter of men and machines. It demands an *experience* that can come only from intimate and long-continued contact with industrial ring problems.

Nowhere is such experience more important than in the production of aviation rings. The extensive use that the world's leading aircraft engine builders make of American Hammered Piston Rings shows how well they meet the most iron-clad requirements.

KOPPERS COMPANY
AMERICAN HAMMERED PISTON RING DIVISION
BALTIMORE, MARYLAND

Official Photograph—Courtesy U. S. Navy

American Hammered Piston Rings

a KOPPERS product

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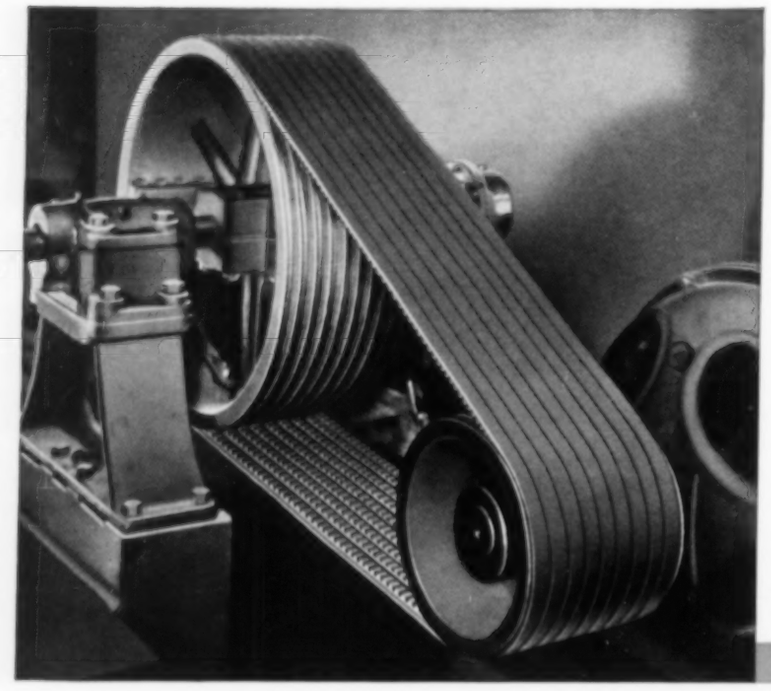
Today, when Production Schedules demand Greater Plant Capacity

DAYTON, *THE GREATEST NAME IN V-BELTS,* is ready with—



The Only V-Belt with Patented Built-to-Bend Construction

With their greater flexibility and tremendous gripping power, Dayton V-Belts need to contact only one-third of the pulley. The motor can be set much closer to the machine. That means more machines—more production capacity—in the same space.

If peak production has cramped your floor space—perhaps you need not wait for a new factory addition. And when you install Dayton V-Belts, you are all set for smoother, more efficient transmission of power. Because of Dayton's patented features, there's less loss of power, less vibration, less wear on bearings. What's more, Dayton V-Belt Drives, with exclusive Daytex Cord construction, run cooler and stand up longer. So, for plus-power transmission with important savings in floor space, call your nearest Dayton Distributor.

THE DAYTON RUBBER MFG. COMPANY
DAYTON, OHIO
The World's Largest Manufacturer of V-Belts

FOR A LONG PULL and A HARD PULL IT'S...

Exhaustive tests prove that Dayton V-Belts with Daytex Cord have the *extra* strength, *extra* flexibility, *extra* life and *extra* gripping power to deliver plus-power transmission under rigorous conditions at less-cost-per-month-of-service.

The Plus-Value DAYTON V-BELT	
1	√+ LONGER LIFE.
2	√+ STRENGTH.
3	√+ FLEXIBILITY.
4	√+ COOLER RUNNING.
5	√+ GRIPPING POWER.

Dayton V-BELT DRIVES

WITH DAYTEX CORD

Coal is also the co-ordinated effort of thousands of executives and technicians and hundreds of thousands of miners, combining brains and muscle, explosives, machines, and materials to extract half a billion tons annually from the ground.

We are proud of our contribution to that effort, and as individuals we value our host of friendships in the coal-mining industry.

We'll be glad to see you at our booth at the Coal Show in Cincinnati, April 28-May 2, 1941.

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Clean Air..Right Oil

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The Emblem of
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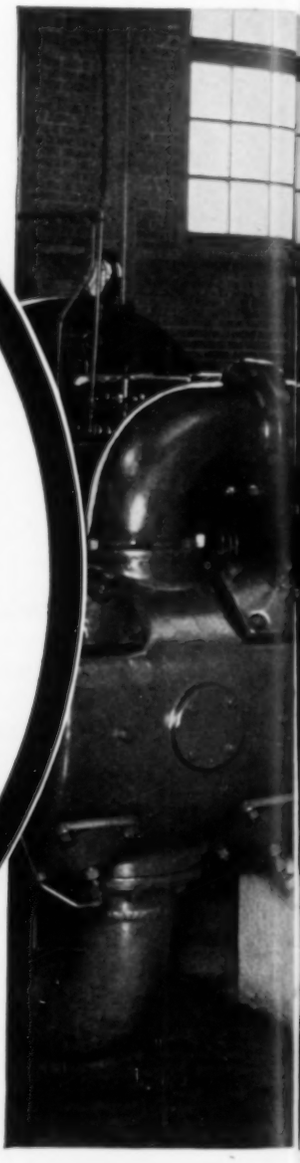

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YOU'LL BENEFIT FROM: 75 YEARS' LUBRICATION EXPERIENCE • PRODUCTS APPROVED BY ENGINE BUILDERS •

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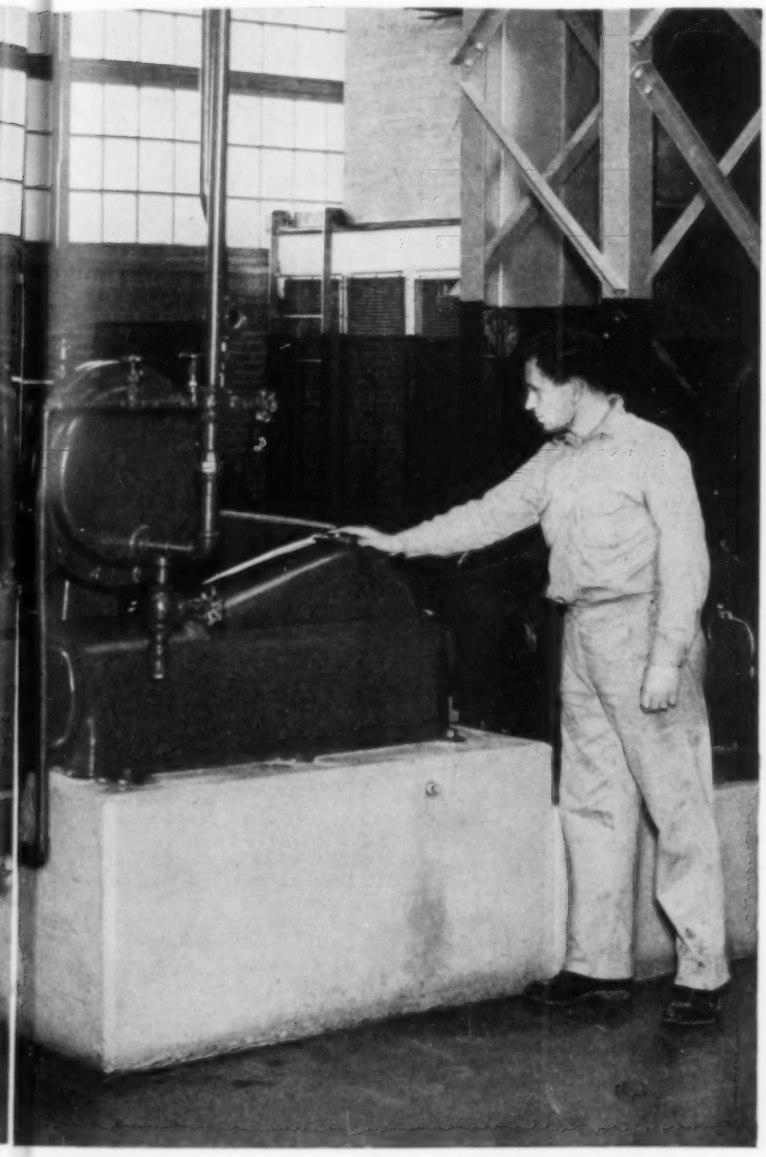

YOU MUST HAVE ALL THREE of these "headliners" to get safe, efficient air compression.

One sure way to get them is to call in your Socony-Vacuum engineer.

He will work with your men to place air sources and filters properly. He will recommend the right grade of Gargoyle D. T. E. Oil and suggest ways of getting minimum feeds.

By following this simple, effective plan, you will benefit from two real advantages:

1. **CLEAN COMPRESSOR AND SYSTEM . . . freedom from harmful deposits.**
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THE RIGHT OIL FOR EACH JOB • NEW LUBRICANTS AHEAD OF NEW NEEDS •

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How Much Is A Shovel-Full?

Do You Know That These Form Tying Methods Are As Up-To-Date As The Most Modern Diesel Shovel?

Of course a gang of shovel-wielders could nibble out that excavation for you. And don't laugh at the idea!

RICHMOND 10-WAY PROFIT PLAN

1—Over 58 different form tying devices to choose from.
2—Always cost less to use than wire, band or rod ties.
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9—You borrow working parts paying only for ties in the job.
10—Free estimating service specifying job quantities needed.

The chances are, that if you're not using Richmond you're still in "the pick and shovel era" on your concrete form work.

Thousands of contractors, all over the country, use Richmond on every job. Money is the only reason. Money saved on the job. Money in pocket. Once you, too, begin to rely on Richmond, your "take" on concrete jobs is bound to be a lot better. Richmond's 10-way profit plan guarantees it!

FREE ESTIMATING SERVICE

By 15 especially experienced engineers to tell you exactly how many ties are needed, what kind, how to do the job fast for extra profit. Plus 9 other "profit-savers" features in our 10-way profit plan,

For complete product information see our pages in Sweets Catalog Engineering & Contractors and Architectural Sections or write direct to Dept. Q.

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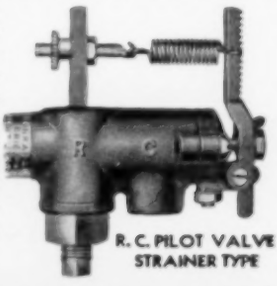
R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET · ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

Hard ROCK MINING is EASIER, SAFER, MORE PRODUCTIVE—

. . WITH THESE FAMOUS AIDS ON - THE - JOB!

Better efficiency—better safety—better all-around operating conditions in the mine! BETTER LIGHT plus assured head protection provide these advantages for every miner and every owner wherever Edison Lamps and M.S.A. Skullgards are installed.

The experience of mining operators throughout the world—who employ more than 450,000 Edison Electric Cap Lamps and M.S.A. Skullgards—is your assurance of *profitable results* when you decide to modernize your property with these safeguards. The proved facts are quickly told—and easily demonstrable in your mine. Let us arrange to do so!

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M-S-A SKULLGARDS

MINE SAFETY APPLIANCES COMPANY
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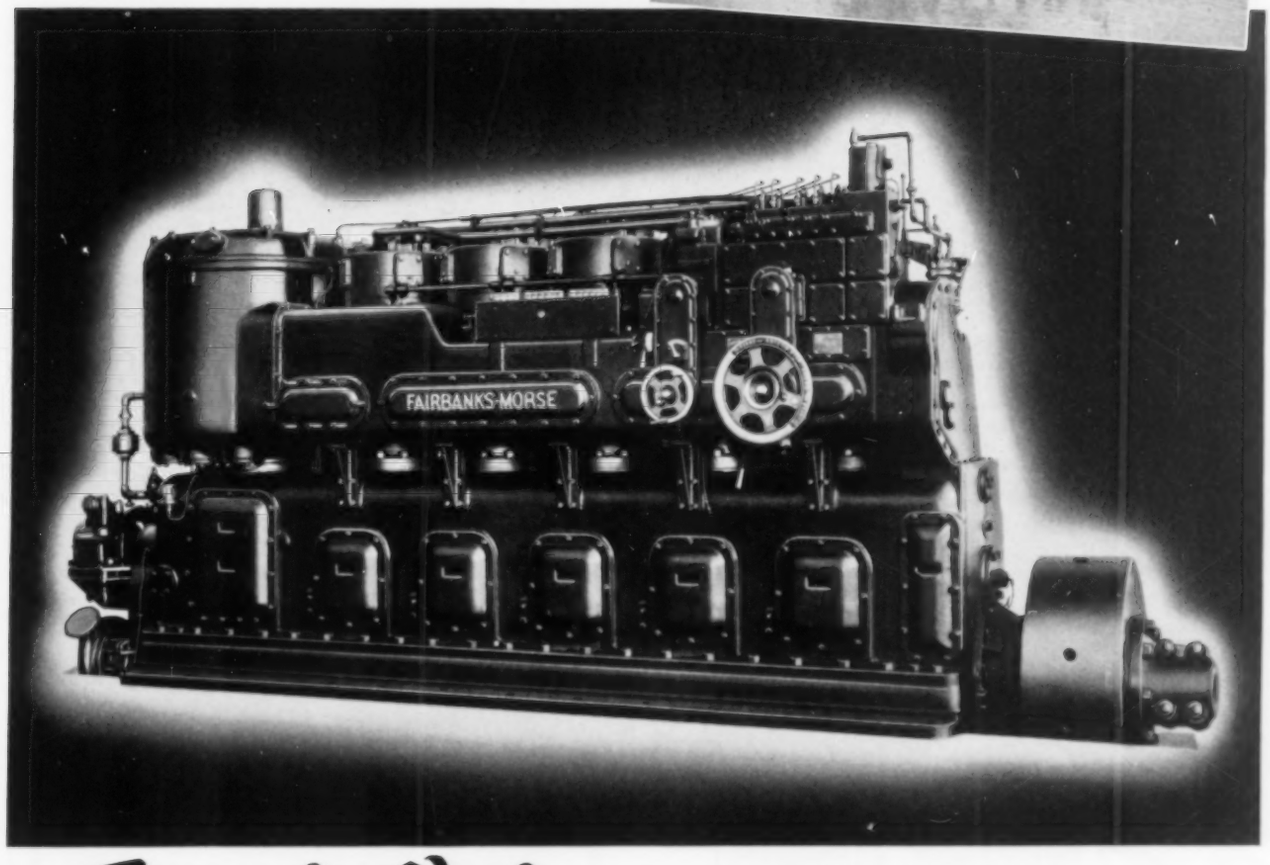
LUBRICATORS
ON THE TRI-CITIES TUG BOAT



Illustrated, the Fairbanks-Morse 5 cylinder Model 37E12 Diesel Marine Engine lubricated by a Madison-Kipp Fresh Oil Lubricator.

Fresh Oil BY THE MEASURED DROP—
LUBRICATES FAIRBANKS-MORSE DIESEL ENGINES

Fresh Oil by the measured drop from a Madison-Kipp Lubricator is without question the most dependable method of lubrication ever developed. It is significant to know that most of the manufacturers who equip with Madison-Kipp Lubricators are undisputed leaders in their respective fields. Correct lubrication engineering is of vital importance to the service and life of any machine. Madison-Kipp specialists will be glad to assist in solving original equipment oiling problems. Write today for further information.

Complete:
DIE CASTING SERVICE
FRESH OIL LUBRICATORS
HIGH SPEED AIR TOOLS

Sole Agent in England: Wm. Coulthard & Co., Ltd., Carlisle

MADISON-KIPP CORPORATION, 202 Waubesa St., Madison, Wis., U.S.A.

DESIGN

In making the predecessor of this plug and jack we devised improvements in design, materials and mechanics which Electrical Research Products Company approved.

MATERIALS

3/32" aluminum goes into this lens cone for an aerial camera. But we are constantly working with materials ranging from Beryllium Copper to Phenolic Plastics.

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Extreme precision in size and location of holes had to be observed on this chassis. Fabricating it saved plenty of money over estimated die costs.

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Organized, equipped and manned to do a wide variety of highly specialized jobs under one roof — as you notice from the panel to the left—it is likely that we can engineer some worthwhile improvements or economies by fabricating your product or part of it. We would welcome the chance to at least discuss this with you.

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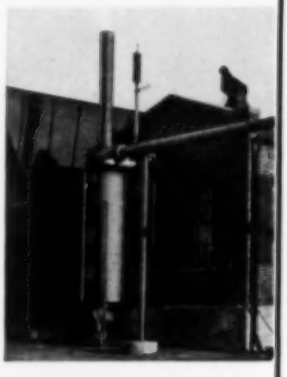
MAXIM SILENCERS

KILL NOISE AND PULSATION

Maxim silencers effectively eliminate noise and pulsation from the exhaust or intake of internal combustion engines, from high or low pressure steam discharges, from compressor intakes, blowers, etc. Consult Maxim on your next silencing problem.



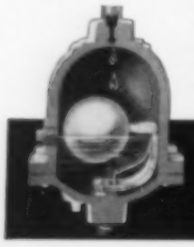
THE MAXIM SILENCER CO.
85 Homestead Ave. HARTFORD, Conn.

Double Barrelled PROTECTION

for users of COMPRESSED AIR

WITH compressed air costing as much as it does (10 to 20 times as much as steam) few plants can afford to waste it. At the same time, compressed air tanks, lines, separators and aftercoolers have to be opened up every little while to drain the water out of them!

An ideal solution for this common problem is offered by the new "Snap Action" Armstrong Air Trap. Danger of dirt holding valve open is virtually eliminated by the "Snap Action" valve. No dribbling. Trap is self-priming. Large capacity. All-stainless steel mechanism. Send for interesting new bulletin ARMSTRONG MACHINE WORK, 885 Maple St., Three Rivers, Mich.



THE ARMSTRONG "SNAP-ACTION" AIR TRAP

HALF-WAY PROTECTION COSTS YOU MONEY!

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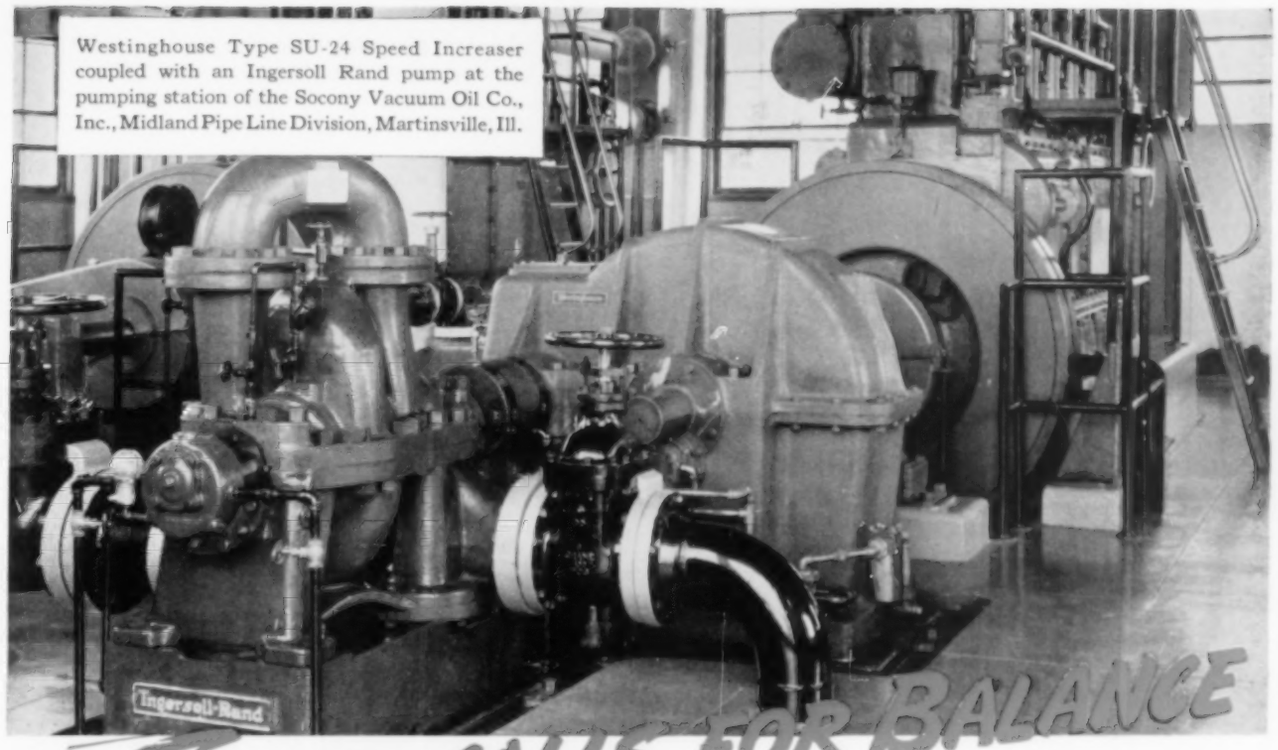
The best safety equipment is useless if it won't be worn. WILLSON Goggles with their super-tough lenses not only offer proper protection—they are especially designed to afford maximum comfort. Style WV20 shown in illustration is one of more than 300 different styles of WILLSON Goggles for every conceivable industrial use and condition. Consult your WILLSON Safety Service Representative or write direct for complete information.

WILLSON DOUBLE
PRODUCTS INCORPORATED
READING, PA., U.S.A. Established 1870

HELMETS
GOGGLES
RESPIRATORS
GAS MASKS



Westinghouse Type SU-24 Speed Increaser coupled with an Ingersoll Rand pump at the pumping station of the Socony Vacuum Oil Co., Inc., Midland Pipe Line Division, Martinsville, Ill.

SPEED CALLS FOR BALANCE

6,000 RPM—that's the speed at which the pinion shaft in speed increasing units often turns. Vibration caused by improperly balanced gears spells trouble at any speed. That's why all gears in Westinghouse Type SU Speed Increasers are dynamically balanced on a special machine developed by the Westinghouse Research Laboratory.

Smooth, quiet operation is further assured by the accuracy with which gear teeth mesh—accuracy made possible by the hobbing process of gear cutting, the most accurate method ever developed.

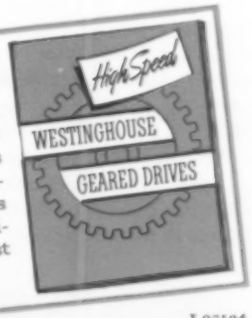
The entire gear assembly in Westinghouse Type SU Speed Increasers is enclosed in an extra heavy cast-iron housing that assures permanent alignment of rotating parts and dampens external vibration. Bearings are oversize and lined with a special high-grade long wearing babbitt to hold bearing maintenance at a minimum.

And with a Westinghouse Speed Increaser there is never any danger of gears or bearings running dry. A positive pressure circulating oil system keeps every moving part properly lubricated while an oil spray is directed at the mesh line of the gears. An oil strainer keeps the lubricant free from dust and grit while a special cooler dissipates heat.

Westinghouse Electric & Mfg. Co., Dept. 7-N,
East Pittsburgh, Pa.

WRITE FOR THIS FREE BOOK

Westinghouse has prepared a special 24-page book describing Type SU Speed Increaser Units. It contains detailed specifications and helpful application data for speed increasers used with electric motor and multi-cylinder engine drives. It's free. Just ask for booklet DD-3650.



J-07184

Westinghouse Geared Drives

W
WESTINGHOUSE ELECTRIC

MY ADVICE IS . . .
USE EXCELLAY!
FROM THE DAILY REPORT OF A TIGER BRAND WIRE ROPE ENGINEER
I was just walking into Mr. Brown's office when one of his engineers called this morning.
"My advice to you," he said on the phone, "is use Excellay. No other rope can touch it. Next time the Tiger Brand Engineer comes in I'll have him see you. He's helped me out dozens of times."
Then he looked up and saw me. "Well," he said, "speak of the devil and there he is." The three of us went over the specifications together, and decided that Brown was right -- Excellay will do the best all-round job.
Yours,
Jim

KNOWING wire rope from A to Z—how to choose it and how to use it—that's the job of the American Tiger Brand Wire Rope Engineers. It will pay you to make use of their specialized knowledge and experience, gained through years of practical service to wire rope users in every industry, everywhere.

These men do more than help you select the right rope for a given application. If for any reason you are not getting full performance, they can help you locate the trouble and suggest practical ways and means for eliminating the difficulty. Get to know the American Tiger Brand Wire Rope Engineer who contacts you. Discuss your wire rope problems with him. Get his advice on every wire rope specification.

He can help you get a full dollar's worth of performance out of every dollar you invest in wire rope.

USS

EXCELLAY
Preformed
WIRE ROPE

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

UNITED STATES STEEL

DA-35 DRIFTERS AND JACKBITS

A Combination That Can't Be Beat!

They Reduce Drilling Costs

Drill Jumbo with 5 DA-35 Power-Feed Drifters at heading of Carlton Tunnel, Cripple Creek, Colorado.

Here's the Proof

● At the Carlton Tunnel, DA-35 Power-Feed Drifters and Jackbits are used exclusively; and new drilling records are being established month after month. The five-mile point of the tunnel was reached on December 23, 1940 — in 513 working days.

Jackbits were adopted as standard after severe tests had proved that they speeded up the round and substantially reduced the costs.

The drilling time per foot of heading advanced dropped from 16.4 to 13.5 minutes when Jackbits were put on the job.

If you are not already using DA-35 Power-Feed Drifters and Jackbits, you too, can benefit by putting them to work. They make a team that can't be beat.

The use of Jackbits made tremendous savings in the transportation of steel. Dull bits are quickly and easily detached and replaced with sharp ones by the steel nippers at the heading. All dull bits are reconditioned with an I-R hot mill.

Ingersoll-Rand

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A TRADE MARK THAT SPELLS *Quality* IN ANY LANGUAGE

THE trade-mark "TIMKEN" in conjunction with a picture of the product which it identifies, tells a story that is instantly understood wherever it is seen. It means the "best there is" in tapered roller bearings, alloy steel, alloy steel seamless tubing, and removable rock bits—all products of:

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO